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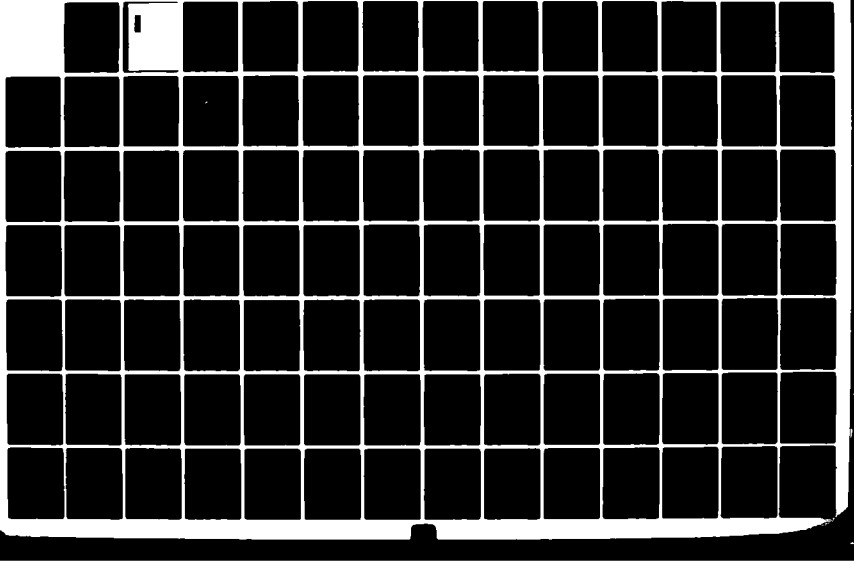

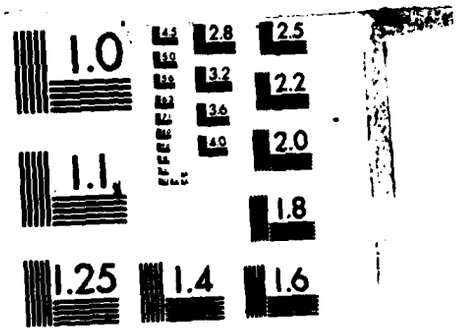

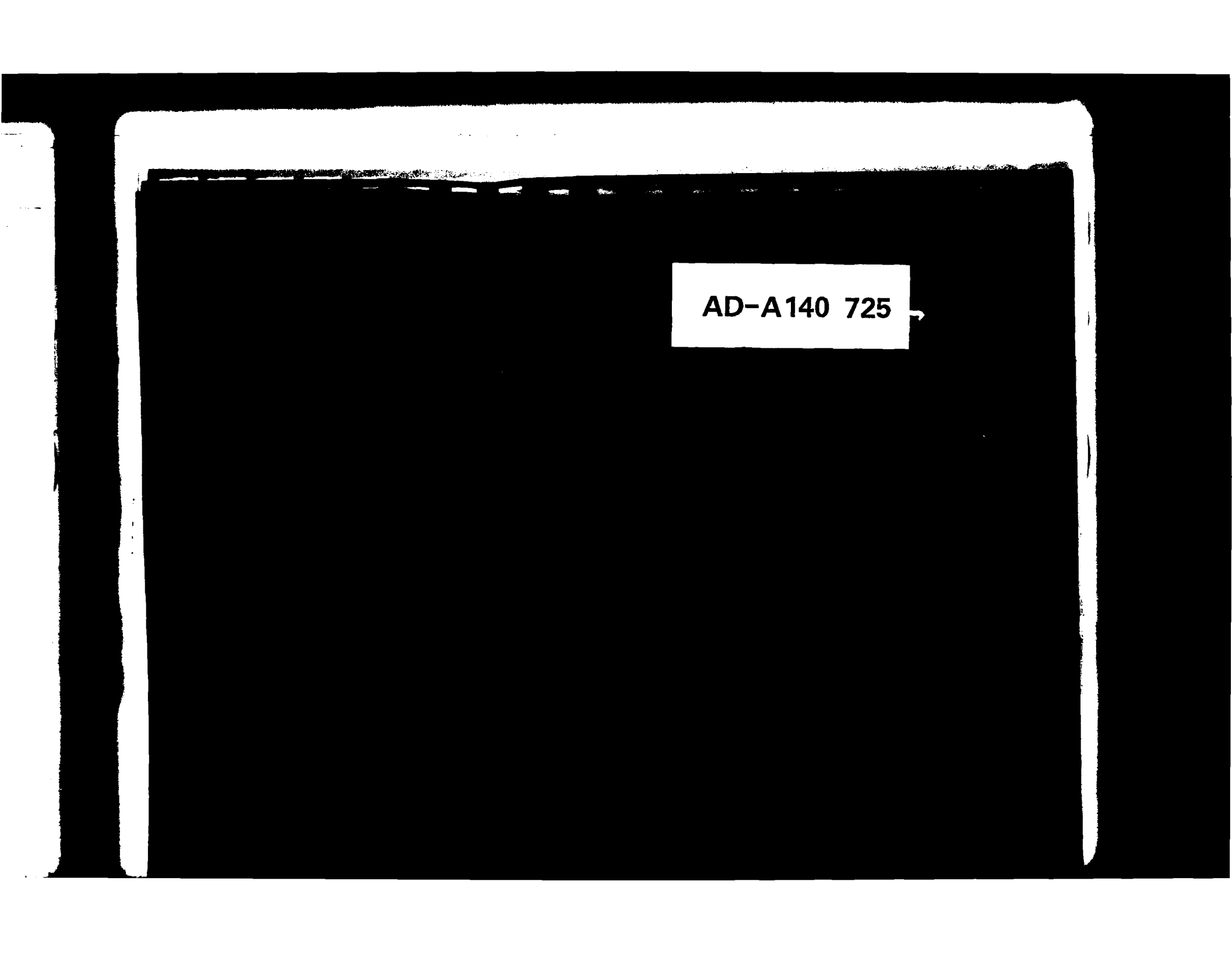
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This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin. The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and

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problems, to determine priorities for immediate and longrange action, and to identify the capabilities of various governmental units for implementing the actions.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

The Wild Rice River Subbasin occupies 2,233 square miles of the extreme southwest portion of the Red River Basin. The subbasin is comprised of portions of four counties in North Dakota, including Ramsom, Sargent, Richland and Cass counties. In addition, portions of Marshall and Roberts County in South Dakota are included in the study area. The subbasin is bordered on the north by the Sheyenne River Subbasin and to the east and south by the Main Stem and Bois de Sioux-Mustinka River Subbasin, respectively.

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RECONNAISSANCE REPORT: RED RIVER OF THE NORTH BASIN, WILD RICE RIVER SUBBASIN

Prepared for:

U.S. Army Corps of Engineers
St. Paul District
St. Paul, Minnesota

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I. THE STUDY AND REPORT

This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North Study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and problems, to determine priorities for immediate and long-range action, and to identify the capabilities of various governmental units for implementing the actions.

The Wild Rice River Subbasin is a water resource planning unit located primarily in the southeastern North Dakota portion of the Red River Basin. This report describes the social, economic, and environmental resources of the subbasin, identifies the water-related problems, needs, and desires, and suggests measures for meeting the needs, particularly in the area of flood control.

The report was prepared almost entirely on the basis of secondary information. However, some telephone contacts were made to verify information and to acquire a more complete picture of local conditions. The only comprehensive report available on the subbasin is a 1947 appendix to the Red River of the North Basin survey report, which was published by the St. Paul District Corps of Engineers. Other published sources on the subbasin include:

1. Geology and Water Resources of Marshall County, South Dakota, Part I: Geology and Water Resources, Neil C. Koch, which was published in 1975 by the U.S. Geological Survey, Department of Natural Resources, and discusses geological features and water resources of the county.
2. Soil Survey of Marshall County, South Dakota, which was published by the United States Department of Agriculture, Soil Conservation Service (SCS) in 1975, is a detailed discussion of the soils in the county.

3. Watershed Work Plan for Watershed Protection and Flood Prevention, Wild Rice "B" Watershed, Richland and Sargent Counties, North Dakota, which was published in 1963 by the SCS, describes the watershed's problems and outlines a work plan for flood prevention, agricultural water management, and fish and wildlife development.

4. Watershed Work Plan for Watershed Protection and Flood Prevention, Tewaukon Watershed in Marshall County, South Dakota and Sargent County, North Dakota, which was published in 1958 by the SCS, describes the watershed's problems and proposes a project for watershed protection and flood prevention.

5. Watershed Work Plan for Watershed Protection and Flood Prevention, Wild Rice Creek Watershed, Marshall County, South Dakota and Sargent County, North Dakota, which was published in 1957 by the SCS, describes the watershed's problems and proposes a project for watershed protection and flood prevention.

6. Report of Preliminary Investigation, Veblen Watershed (Shortfoot Creek), Marshall and Roberts Counties, South Dakota, Sargent and Richland Counties, North Dakota, which was published in 1960 decribes the watershed briefly and its flood prevention and drainage problems.

7. Application for Planning Assistance under the Watershed Protection and Flood Prevention Act, Crooked Creek Sub-watershed, which was published by the Wild Rice Soil Conservation Service in 1955, is a request for assistance in developing a work plan for the watershed.

8. Correspondence to Governor Arthur Link, North Dakota, from the St. Paul District Corps of Engineers, written in 1973, describes the Corps' plans for projects in North Dakota.

9. Section 2 Reconnaissance Report, Emergency Snagging and Clearing for Flood Control, Wild Rice River, Cass County, North Dakota, which was published in 1975 by the St. Paul District Corps of Engineers, is a reconnaissance report concerned with the snagging and clearing of the lower part of the Wild Rice River in Cass County.

10. Flood Reconnaissance Report on Antelope Creek, North Dakota, which was published by the St. Paul District Corps of Engineers in 1963, is a recommendation that Federal assistance for flood control in the Antelope Creek Basin be eliminated and further study be made part of the comprehensive basin study on the Red River of the North Basin.

11. Plan of Study for an Interim Survey for Flood Control and Related Purposes on Antelope Creek, which was published in 1971 by the St. Paul District Corps of Engineers, is a plan of study for improvements on the creek to control flooding.

In addition, the subbasin received partial coverage in the Souris-Red-Rainy River Basins Comprehensive Study, which was published by the Souris-Red Rainy River Basins Commission in 1972, and in the Red River of the North Basin Plan of Study, which was published by the St. Paul District Corps of Engineers in 1977.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

II. DESCRIPTION OF STUDY AREA

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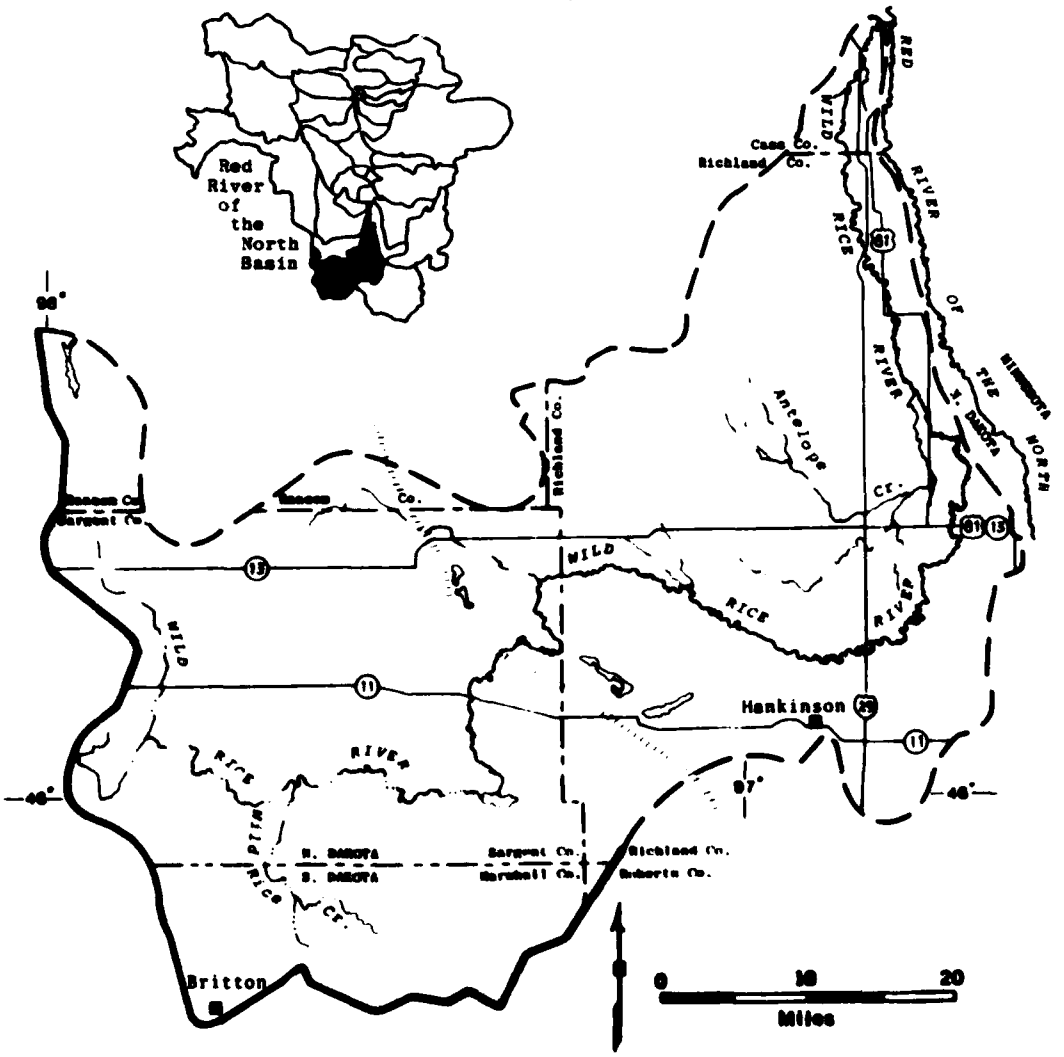
The Wild Rice River Subbasin (Figure I) occupies 2,233 square miles of the extreme southwest portion of the Red River Basin. The subbasin is comprised of portions of four counties in North Dakota, including Ransom, Sargent, Richland and Cass counties. In addition, portions of Marshall and Roberts County in South Dakota are included in the study area. The subbasin is bordered on the north by the Sheyenne River Subbasin and to the east and south by the Main Stem and Bois de Sioux-Mustinka River subbasins, respectively.

The Wild Rice River rises in the glaciated uplands in western Sargent County, North Dakota and flows easterly through Lake Tewaukon before turning northward to join the Red River in Cass County, 18 miles south of Fargo. The entire 243-mile course of the river traverses a widely varied landscape which, east of Lake Tewaukon, is characterized by morainic hills, large swamps, low swales and potholes. In this area, the Sisseton Hills are the most prominent relief feature.

The valley is eight feet deep and 200 feet wide at the outlet of Lake Tewaukon. As the river flows eastward, the valley width varies between 0.1 and 1.0 mile, with depths of 35 feet. The valley disappears almost entirely as the river channel meanders across the broad flat plain of the Red River Valley. The channel width and depth increases to about 120 and 12 feet, respectively, east of Lake Tewaukon to the river's mouth. The average gradient of the Wild Rice River is about 1.7 feet per mile, with the steepest slopes (4.2 feet per mile) occurring above Lake Tewaukon. Stream flow is not constant, and at times each year there is no flow at all.

The gently rolling and flat landscape of the subbasin is ideally suited to agriculture. In fact, 78 percent of the subbasin is cultivated, and another 14 percent is pasture. Natural drainage in the subbasin, however, is poorly developed because of the region's flatness. Agricultural damages from floodwaters are therefore potentially devastating. Much of the runoff from snow melt or precipitation in the upper portion of the subbasin drains directly into small marshes, lakes and potholes as a result of overland flooding. Channel flooding is a more serious problem along the Great Bend of the river to Antelope Creek and the river's headwaters.



Source: [illegible] South Research Institute.

Figure I. WILD RICE RIVER SUBBASIN

III. PROBLEMS, NEEDS, AND DESIRES

III. PROBLEMS, NEEDS, AND DESIRES

The primary water-related problems, needs, and desires in the Red River Basin are flood control, fish and wildlife conservation and enhancement, recreation, water supply, water quality, erosion control, irrigation, wastewater management, and hydropower. Various water-related problems, needs, and desires have been identified for the Wild Rice River Subbasin in previous planning reports on the basis of analysis of conditions and public and agency comments. The list of problems, needs, and desires for the subbasin is the same as the list for the Red River Basin as a whole. Each problem is discussed separately below, with an emphasis on flooding problems.

Flooding Problems

Nature of the Problems

Floods within the subbasin are almost an annual event. Most flooding conditions are brought about by spring snowmelt, often combined with spring rains. These conditions cause delays in seeding crops which, given the short growing season in this area, results in a significant reduction in yields. In some circumstances, if the water stays on the ground too long it may be impossible to engage in planting operations for the season.

Two separate types of flooding occur: the most damaging type associated with river bank overflow (overbank flooding) and another type caused by runoff from snowmelt or heavy rainfall impounded by plugged culverts and ditches within sections of land bounded by roadways on earthen fill (overland flooding). In overland flooding, the trapped water slowly accumulates until it overflows the roadways and inundates section after section of land as it moves overland in the direction of the regional slope until reaching river or stream channels.

Most storm runoff in the upper portion of the basin is not immediately adjacent to the Wild Rice River or tributary coulees. This runoff finds its way into small marshes and potholes where evaporation or percolation is extended. The abundance of these small depressions makes it impractical

to operate agricultural machinery on the irregular pattern of associated dry areas. Drainage in the lower half of the subbasin is more adequate, but runoff is detained because of the nearly level topography and inadequate drainage system. These conditions, combined with flooding that is occasionally contributed as a result of overland flow from the Sheyenne River and backwater from the Red River, create major agricultural losses on the floodplain, which is 70 percent cultivated.

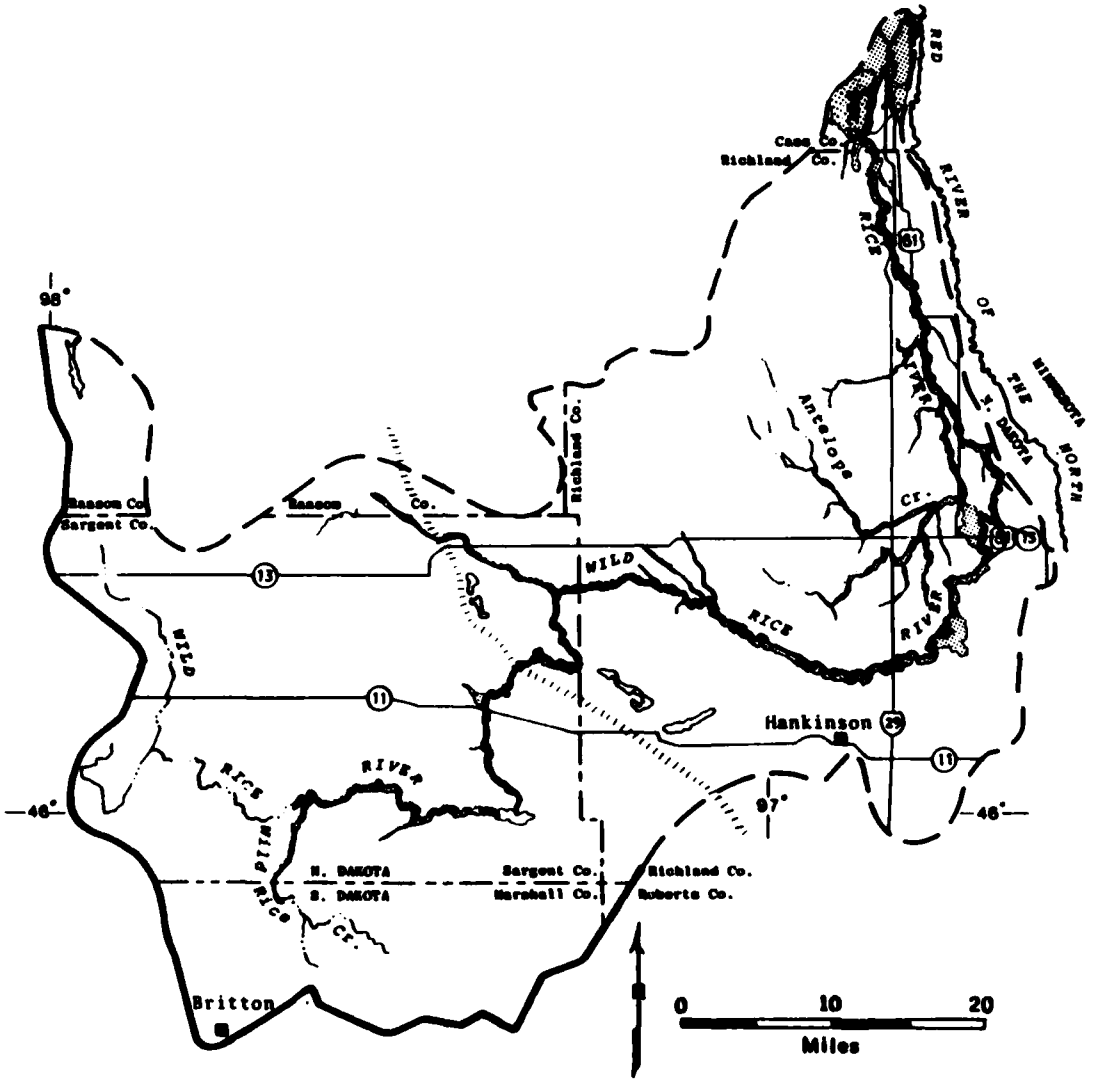
Serious flood damage also results from high intensity summer storms which occur annually in some parts of the subbasin. High flows from summer rains exceed channel capacity, which has been reduced as a result of overgrowth of bushes and trees. Because of inadequate outlets and flat topography, considerable time elapses before this water returns to the channels. Some crops are damaged even from short periods of inundation, resulting in lower yields and poorer quality of agricultural products.

The topography of the subbasin varies greatly from its source to its mouth. From the headwaters north of the Sisseton Hills to Lake Tewaukon, the river flows through an area of drift prairie characterized by morainic hills, large swamps, low swales and potholes with no well-established drainage system. As the river continues on towards the Red River Valley plain, the valley depth diminishes then completely disappears. Due to the flat terrain of the valley plain, once the river overflows its banks a large area is flooded with a relatively small change in flood level.

Location and Extent

Figure II depicts the 100-year floodplain for the Wild Rice River Subbasin. Prior to this study, no attempt had been made to publish even a generalized delineation of the entire subbasin. A number of sources were investigated in order to produce the present delineation. Among these were: (1) U.S. Geological Survey (USGS) Flood Prone Area Maps at 1:24,000 scale; (2) Federal Insurance Administration flood maps (various scales); (3) published secondary sources describing flooded areas; and (4) USGS 7 ½ minute topographic maps.

The map is thus a composite of available sources supplemented by inferences where necessary. Because the sources were incomplete and based on surveys



Source: Gulf South Research Institute.

Figure II. 100-YEAR FLOODPLAIN

differing in purpose and accuracy, it should be understood that Figure II constitutes a generalized delineation intended only for general planning purposes. A more complete description of sources and limitations is given in Appendix A.

According to this preliminary delineation, the Wild Rice floodplain comprises 52,000 acres. Major components include: Wild Rice drift prairie, 4,000 acres; Drift Prairie to Great Bend, 8,000 acres; Wild Rice at Great Bend to Main Stem, 28,000 acres; Wild Rice at the Main Stem, 10,000 acres; Antelope Creek, 2,000 acres. No additional areas are derived through descriptive sources.

The floodplain associated with the upland drift prairie is composed of swamps, swales and small lakes which are interconnected by shallow, poorly defined channels. However, this system is adequate for carrying flows experienced in the area. East of Lake Tewaukon the floodplain widens as the channel increases in width lower in the Drift Prairie.

From the Drift Prairie to Great Bend and on to the Main Stem, the river channel and associated floodplain continue to increase in size. Maximum width of the channel in this area is 120 feet. The winding, constricted nature of the channel past Great Bend increases the extent of spring overflow significantly. Just south of Dwight, North Dakota the floodplains of the Wild Rice River and Antelope Creek meet.

The Wild Rice River flows through a portion of the Sheyenne Delta and into the main stem Red River with a winding characteristic similar to the preceeding segment. The associated floodplain accounts for 10,000 acres in the Main Stem flood area.

Some 2,000 acres of floodplain are located adjacent to Antelope Creek. Just east of the confluence of the North and South branches of the creek, the floodplain meets that of the Wild Rice River. A number of natural water courses enter Antelope Creek in its downstream reaches, contributing to the area of the combined Wild Rice and Antelope Creek floodplain.

Flood Damages

The primary areas affected by flooding in the subbasin are urban, agricultural and environmental in nature. There are no urban areas in the subbasin that are subjected to recurrent flooding. Urban and rural damages are the only damage categories taken into account in the computation of average annual flood damages.

Present average annual flood damages in the subbasin are estimated at $661,300. This figure accounts for two percent of the Red River of the North basinwide average annual flood damage total. The two basic classifications into which average annual damages are divided are urban and rural. Damages to residences, businesses (commercial and industrial), and public facilities (streets, sewers, utilities, etc.) are reported as urban damages. Rural damages are damages to crops, other agricultural assets (fences, machinery and farm buildings, etc.) and transportation facilities. Average annual urban flood damages are reported to be minor, and therefore average annual rural flood damages account for 100 percent of the total average annual damages in the subbasin.

There were no urban flood damages reported to have been sustained in either the 1975 or 1979 flood events.

Estimated average annual rural flood damages and the rural flood damages sustained in the 1975 and 1979 flood events are presented in Table 1. Rural flood damages incurred in the 1975 flood event included $9.1 million in crop damages, $5.5 million in damages to other agricultural assets and $781,100 in transportation damages. Total rural flood damages sustained in the flood event of 1975 were $15.4 million. The 1979 flood event caused $415,000 of total rural flood damages. This figure included $312,000 in crop damages, $59,000 in damages to other agricultural assets, and $44,000 in transportation damages. Estimated average annual rural flood damages included $476,500 in crop damages, $158,800 in other agricultural damages, and $26,000 in transportation damages. Total average annual rural flood damages are estimated at $661,300.

Environmental Concerns

Much of the native woodlands, wetlands, and prairie has been converted to cropland, pastureland, and other land uses. Cropland, range and pasture, and urban uses represent 94.7 percent (1,353,376 acres) of the total

Table 1

WILD RICE RIVER SUBBASIN, ESTIMATED 1975, 1979
AND AVERAGE ANNUAL RURAL FLOOD DAMAGES
(Thousands of 1979 Dollars)

Category	Year		Average Annual
	1975	1979	
Crops	$ 9,107.4	$312.0	$476.5
Other Agricultural	5,485.1	59.0	158.8
Transportation	781.1	44.0	26.0
TOTAL	$15,373.6	$415.0	$661.3

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Reports, 1975, 1979; and Gulf South Research Institute.

subbasin area (1,429,120 acres). Forest, the most important wildlife habitat type in terms of species composition, constitutes only 0.2 percent (2,858 acres) of the total area. Woodlands are restricted mainly to the floodplains along the streams, where extensive streambank clearing has adversely affected the integrity of the vegetation community, and to planted shelterbelts and windbreaks. Most wetlands have been drained in the Lake Agassiz bed, and extensive drainage has occurred in the drift prairie or Prairie Pothole Region. A substantial amount of the native prairie communities have been eliminated or altered by agricultural development. Some prairie still remains in certain locations, particularly in that portion of the Sheyenne National Grassland in the northcentral part of the subbasin in Richland County (Soil Conservation Service, 1963; U.S. Fish and Wildlife Service, 1979; Upper Mississippi River Basin Commission, 1977; Wanek, 1965). There is a need to protect, conserve, and enhance the three major wildlife habitats in the subbasin.

Other problems concerning wildlife which have been recognized include the decline of furbearer populations in portions of the Wild Rice River between Lake Tewaukon and the Red River (U.S. Fish and Wildlife Service, 1979).

Also, the Soil Conservation Service (1963) was concerned with the provision of reliable water supplies in the Wild Rice "B" Watershed (Richland and Sargent counties) to develop wetlands and enhance existing wetlands. Dependable water supplies would stabilize waterfowl production in the natural basins during dry years. Waterfowl production in the natural wetlands of the subbasin is related to the amount of water present during the breeding season. When wetlands are not provided with adequate water from snowmelt and precipitation during the spring and summer, then waterfowl breeding and nesting activities are curtailed due to lack of suitable, "wet" habitat.

A major problem pertaining to both aquatic biota and wildlife is inadequate streamflows during late summer, fall, and winter. For example, all streams in Marshall County, South Dakota, are intermittent. They exhibit highest flows in the spring when water is available in runoff from snowmelt and precipitation. Although most of the South Dakota streams tributary to the Wild Rice River are spring fed, their total discharge is about equal to stream losses except during the wet spring months. Many of these small tributaries will dry up in the beginning of summer. Water quality is also a problem in the subbasin's streams and lakes. Pollution in the form of agricultural and feedlot runoff and extensive channelization and streambank clearing adversely affect the Wild Rice River and its aquatic life. Further, nutrients in agricultural runoff have caused accelerated eutrophication in many of the area's lakes (Koch, 1975; U.S. Fish and Wildlife Service, 1979; Upper Mississippi River Basin Commission, 1977). An improvement in these conditions is needed to provide both aquatic biota and wildlife with year-round quality environments. It should be noted that even though the subbasin's surface waters experience these problems, the Wild Rice River between Lake Tewaukon and the Red River has been assigned a high priority fishery value. This reach provides a moderate sport fishery and a moderate production of both sport and forage fishes.

Recreation Problems

The subbasin has significant recreational acreage; however, most of the land is contained in wildlife management areas. The only major water-based recreational site with camping or picnicking facilities

is the Silver Lake Recreation Area, which is located in the southwestern portion of the subbasin about 20 to 30 miles away from Milnor and Hankinson. The northeastern portion of the subbasin near the Red River has no recreational facilities because of the lack of lakes and forest tracts in the area.

Water quality problems in the Wild Rice River caused by agricultural runoff detract from the recreational and aesthetic value of the river, particularly in the lower reaches.

Water Quality Problems

Serious water quality problems occur during extensive periods of low or zero flow on the river. At this time, dissolved oxygen concentrations are low, and TDS levels are in excess of the acceptable standards. The surface water quality is further degraded by discharges from municipal waste treatment facilities. Wastewater management will be discussed in a later section. Sulfates generally are found in high concentrations and occasionally exceed the maximum acceptable limits. Naturally occurring high cyanide levels also degrade the river's water quality and impair fish propagation (Upper Mississippi River Basin Commission, 1977; North Dakota Statewide 208 Water Quality Management Plan, 1978).

The groundwater sources of the subbasin generally have the potential to meet future quantity demands; however, the quality of these aquifers is undesirable. Several communities' water supplies contain TDS concentrations of more than 1,000 mg/l. Excessive fluoride concentration, which causes a mottling of tooth enamel, is a problem at Cogswell. Additionally, iron and manganese concentrations are very high in several municipal supplies throughout the subbasin (Souris-Red-Rainy River Basins Commission, 1972).

Water Supply Problems

Several known aquifers in the subbasin have small to moderate potential and should provide enough water to meet the modest municipal requirements. However, the dissolved solids concentrations of the Cogswell, Forman, Gwinner, and Mooreton, North Dakota, water supplies are very high, and better quality water should be sought for these towns. Excessive fluoride is a problem at Cogswell and Abercrombie. Britton, South Dakota has ample supply since a recently built ground well has been utilized. White Lake, which is used by Britton during the summer months, has extremely hard water that is quite expensive to treat.

Erosion Problems

Wind and water erosion occurs throughout the subbasin. Water erosion is damaging to roadsides and streambanks. Problems also exist where tributaries enter the mainstreams, since headcuts are developing and slowly working their way upstream. Wave action is damaging shorelines on lakes. Wind erosion of cultivated fields occurs throughout the subbasin, with heaviest damages on sandy soils. This damages growing crops and reduces productivity. In the winter, when there is little or no snow cover, wind blows sandy soils into depressions, drains, fence rows and tree belts. These wind-blown sediments clog surface drains, thus reducing their capacity substantially.

Irrigation

Only a small portion (10,000 acres) of the total acreage in the North Dakota part of the Red River Basin is being irrigated. Limited amounts of acreage in the subbasin are irrigated due to the lack of adequate water supplies and the quality of the water. If irrigation is to be developed in the subbasin, these problems will have to be overcome.

Waste Water Management

Most of the communities in the subbasin operate a secondary type waste treatment facility. A few of the facilities are operating near or in excess of their design capacity. Three communities do not have public systems. All three are expected to construct new lagoon systems. Prior to 1977, releases from inadequate treatment systems had severely degraded the river's water quality (Shewman and North Dakota State Department of Health, no date; Upper Mississippi River Basin Commission, 1977). Table 2 lists the waste treatment facilities and needs of fifteen communities within the subbasin.

Hydropower

There are three dams located on the Wild Rice River in Sargent County within the subbasin. These facilities were named by the U.S. Army Corps of Engineers' Institute for Water Resources as being potential hydroelectric sites. The dams were built primarily for flood control purposes and are classified as small-scale facilities. The main obstacles to the development of hydropower in the subbasin are the flat topography and low streamflow.

Table 2

WASTE PRODUCTION INVENTORY
WILD RICE RIVER SUBBASIN

City or Industry	Population Served	Design Flow (MGD)	Actual Flow (MGD)	Type Treatment	Surface Area (Total Acres)	Needs or Comments
Barney	81	0.011	0.005	Secondary	1.85	Reline existing cell
Cayuga	116	N/A	0.007	Primary	Septic Tanks	Potential lagoon
Cogswell	203	N/A	0.013	Primary	Septic Tanks	Potential lagoon
Colfax	70	0.020	0.005	Secondary	3.27	Reline Existing cell
Forman	596	0.050	0.039	Secondary	7.90	--
Gwinner	623	0.024	0.041	Secondary	3.8	Inadequate
Hankinson	1,125	0.148	0.073	Secondary	20.0	Construct new lagoon
Havana	156	N/A	0.010	Primary	Septic Tanks	Potential lagoon
Lidgerwood	1,000	0.130	0.065	Secondary	18.0	Construct new lagoon
Mantador	95	0.014	0.006	Secondary	2.14	Construction '74
Milnor	645	0.046	0.042	Secondary	7.40	Construct 1.3 acre lagoon
Mooreton	158	0.015	0.010	Secondary	2.0	Construct new lagoon
Rutland	225	0.024	0.015	Secondary	3.26	--
Walcott	200	0.017	0.013	Secondary	2.8	--
Wyndmere	516	0.074	0.034	Secondary	10.0	--

Sources: Shewman and North Dakota State Department of Health, no date; North Dakota Statewide 208 Water Quality Management Plan, 1978.

Public Perception of Problems and Solutions

The public's perception of problems and solutions in the subbasin is not adequately defined because there have not been any recent public forums in this area. The subbasin's member counties have water management boards.

The primary document for the identification of public perceptions is Appendix G of the Red River of the North Basin Survey Report of 1947. The public hearings of 1942 and 1945 at Wahpeton are documented, in which residents stated a desire for protection from flooding caused by overflow. More rapid and complete drainage of floodplain overflow was also requested. Suggested improvements included channel clearing, straightening and enlarging and reservoir construction.

The plan of survey for Antelope Creek is an additional source for determining public perceptions. A public hearing was held in Wahpeton in 1967 in which Federal, state and local governments and private interests expressed a desire for flood control improvements. Additional meetings were scheduled to discuss alternatives developed.

IV. DESCRIPTION OF SUBBASIN RESOURCES

IV. DESCRIPTION OF SUBBASIN RESOURCES

This section of the report discusses the primary resource conditions within the subbasin that would be affected by a comprehensive water and related land resources plan centering on flood control measures.

Social Characteristics

Between 1970 and 1977, the population of the subbasin decreased by 2.6 percent, reaching a figure of 17,469 in 1977. All of the counties within the subbasin experienced population increases except Marshall and Roberts, which had net out-migration rates of -5.9 and -6.5 percent, respectively. The population growth in Sargent County was the result of natural increase (more births than deaths), while Cass and Richland counties had natural increases and net in-migration (six percent and 2.5 percent, respectively). Ransom did not have a natural increase, but it did experience net in-migration (0.6 percent).

There are no large population centers in the subbasin. The largest town, Britton, South Dakota is located in the southwestern part of the subbasin. Britton's population was 1,496 in 1977, which was 2.1 percent higher than the 1970 population. The towns of Hankinson (1,042) and Lidgerwood (880) lost population between 1970 and 1977. Hankinson's loss was seven percent, and Lidgerwood experienced a 12 percent decline in population. There are 18 additional small towns within the subbasin ranging in population from 61 to 830. The unincorporated population is about 9,386 or 54 percent of the total subbasin population.

The population density for the subbasin decreased from eight persons per square mile in 1970 to 7.8 persons per square mile in 1977. The background of a large portion of the population is Norwegian with some German elements in the eastern portion of the subbasin. The minority population consitutes a very small part of the total population.

Scandinavian is the predominant ethnic group represented in the subbasin, and a significant portion of the population is of Norwegian background. The black minority population is too small to be identified; however, a portion of the Sisseton Reservation lies within the subbasin. The reservation occupies portions of North and South Dakota and is inhabited by members of the Sisseton Wahpeton Sioux Tribe. The reservation occupies 1,493 square miles, and the 1979 tribal population was estimated as 3,945, of which 3,620 resided on reservation lands.

Communities within the subbasin are close-knit, based on home ownership, length and county of residence, and county of employment. Most people in the subbasin own their homes, ranging from 71 percent in Richland County to 80.4 percent in Sargent County. Cass County, with 59.3 percent, is the only one of the six counties in the subbasin in which less than 70 percent of the people own their homes. From 62 percent to 70 percent of the 1970 population occupied the same residence in 1965, with the exception of Cass County (48 percent). Figures for Cass County include the city of Fargo and probably do not accurately reflect patterns in the more rural portions of the county. There is a very high rate of people who did not occupy the same residence during the five-year period but who remained in the same county, ranging from 70 percent in Cass County to 99 percent in Marshall County, South Dakota. Most of the subbasin's population works in the county of residence, varying from 82 percent in Richland County to 93 percent in Sargent County.

Economic Characteristics

Employment

Between 1950 and 1970, agricultural employment in the subbasin decreased due to increased mechanization and farm consolidation. Employment in other sectors fluctuated and resulted in a slight increase in total employment. Between 1970 and 1977, farm employment decreased at a slower pace, and other sectors, especially trade and services, increased. The result was a 36 percent increase in total employment for the subbasin--from 6,099 in 1970 to 8,210 in 1977.

Although the agricultural sector has decreased, it is still the backbone of the subbasin's economy. Employment in agriculture is higher during the spring, summer, and fall, while crops are being planted and harvested, and lower in winter when farming activities decrease. Unemployment in the subbasin averaged about five percent during the 1970's.

Income

Total personal income for the subbasin increased from $89 million to $102 million between 1969 and 1977 (as expressed in 1979 dollars). Farm income accounts for more than 60 percent of the total personal income, and cash grain sales and livestock production amount to 51 percent and 40 percent, respectively, of the total farm income. Average per capita income during the same years increased from $4,949 to $5,841, which was 15 percent lower than the 1979 average income figure of $6,859 for the whole state.

Business and Industrial Activity

Agriculture

Agriculture is the most important sector in the subbasin's economy, and the production of small grains is the primary agricultural component. About 78 percent (or 1,114,714 acres) of the subbasin's land area is under cultivation, and another 13.6 percent is devoted to pasture. Livestock production is also very important in the subbasin. Most of the cattle production is located in the southern part of the subbasin, and it is especially important in the counties of Marshall and Roberts in South Dakota. Hog production is located mainly in the North Dakota portion of the subbasin. Each of the counties in this part of the subbasin was in the top 10 counties in North Dakota in hog production for 1978.

The major crops grown in the subbasin are identified in Table 3. Wheat is the leading crop, accounting for about 30 percent of the harvested acreage, followed by sunflowers, corn, barley, hay, and oats (61 percent, collectively, of the harvested acreage). There are also minor acreages of soybeans, sugarbeets, rye, and flax. The emergence of sunflowers as a major crop within the subbasin occurred during the 1970's. Sunflower

Table 3

1978 CROP STATISTICS, WILD RICE RIVER SUBBASIN

Crop	Harvested Acres	Yield Per Acre	Total Production
Wheat	287,220	26.1 bushels	7,496,442
Sunflowers	167,230	1,325 pounds	221,579,750
Corn	137,300	82.1 bushels	11,272,330
Barley	102,100	41.9 bushels	4,277,990

Source: Gulf South Research Institute.

production in the state of North Dakota increased by more than 50 percent between 1977 and 1978.

Most of the extreme eastern part of the subbasin is prime farmland characterized by gently sloping soils, which are the most productive in the subbasin. There is little livestock, and the most common crops include small grains, sunflowers, soybeans, and sugarbeets. The central portion of the subbasin is 55 to 70 percent prime farmland, and the crops grown here are small grains, sunflowers, corn, and flax. The extreme western and south central portions of the subbasin are composed of steep soils, which are used primarily for rangeland, but flax, grasses, legumes, and some small grains are also grown.

Cropping patterns within the floodplain are very similar to those throughout the subbasin. The primary crops grown include small grains, sunflowers, corn, soybeans, and sugarbeets.

Manufacturing

About 60 percent of the 52 manufacturing establishments in the subbasin are involved directly in the agricultural industry. Eleven establishments produce fertilizer, 10 process grains, seeds, dairy products, or beans, and there are several plants that engage in custom slaughtering. Several manufacturers produce or repair farm implements. Manufacturing employment amounts to about 10 percent of the subbasin's total employment. The manufacturing establishments are listed in Table 4 according to their Standard Industrial Code (SIC) numbers.

Table 4

MANUFACTURING ESTABLISHMENTS, WILD RICE RIVER SUBBASIN

SIC	Description	Estimated Employment
14	Mining of Nonmetallic Minerals	9
15	Building Construction	18
17	Construction-Special Trade Contractors	9
20	Food and Kindred Products	35
23	Apparel Made from Fabrics	18
24	Lumber and Wood Products	20
27	Printing and Publishing	80
30	Rubber and Plastics Products	9
34	Fabricated Metal Products	9
35	Machinery, except Electrical	180
37	Transportation Equipment	110
42	Motor Freight Transportation/Warehousing	45
50	Wholesale Trade-Durable Goods	9
51	Wholesale Trade-Nondurable Goods	120
52	Building Materials and Mobile Home Dealers	22
53	General Merchandise Stores	9
54	Food Stores	18
55	Automotive Dealers and Gasoline Stations	9
75	Automotive Repair	18
76	Miscellaneous Repair Services	9
79	Amusement and Recreation Services	9
TOTAL		763

Source: 1978-1979 Directory of North Dakota Manufacturing.

Trade

In 1977, total trade receipts for the subbasin exceeded $204 million (expressed in 1979 dollars). Nearly 53 percent (or $107.7 million) of the receipts were retail trade. Wholesale trade and selected service receipts were $96.5 million and $8.1 million, respectively, in 1977.

Transportation Network

The subbasin is crossed from north to south by State Highways 32 and 18 and by Interstate 29. Highway 32 runs through the towns of Gwinner, Forman, and Havana, and it intersects the major east-to-west routes, which are State Highways 13 and 11. Highway 18 runs through Wyndmere and Lidgerwood and also provides access to the east-to-west routes. Highways 13 and 11 intersect I-29 in the eastern part of the subbasin. The interstate highway is important to the subbasin because it travels north to the cities of Fargo and Grand Forks, which are major service centers.

The Soo Line Railroad has three rail lines that traverse the subbasin and pass through the towns of Veblen, South Dakota and Cogswell, Forman, Hankinson, Mantador, and Wyndmere, North Dakota. The Chicago, Milwaukee, St. Paul and Pacific Railroad has a line which crosses through the eastern part of the subbasin, passing through the town of Christine. It generally parallels the Red River between Fargo and the South Dakota border and may be subject to flooding. The Burlington Northern Railroad has four rail lines in the subbasin which pass through Rutland, Cayuga, Hankinson, Englevale, Walcott, Dwight, and Wyndmere. The Soo Line crosses the Wild Rice River near Cayuga and at Mantador, and the Burlington Northern crosses the river near Dwight and Rutland.

There are small airports in Wyndmere, Gwinner, Cogswell, and Englevale, North Dakota and in Britton, South Dakota. Most of these airports have very limited facilities with no commercial service.

Land Use

Approximately 78 percent of the subbasin is under cultivation, 13.6 percent is devoted to pasture, 3.7 percent is water, and 3.4 percent is urban development. Only 0.2 percent of the land area is forest, which is found mainly along the river.

Land use in the floodplain of the Wild Rice River does not differ significantly from land use in the subbasin. Most of the floodplain is prime farmland under cultivation, and there are small amounts of forest located along the river. Towns in the floodplain include Cayuga, Mantador, and Great Bend.

Environmental Characteristics

Climate

Climatic data can be obtained from weather stations at Britton, South Dakota and Hankinson, North Dakota. Records at the Hankinson station show mean monthly temperatures ranging from 72°F in the summer to 9°F in the winter. The growing season is approximately 129 days, with the average date of the last killing frost on May 17 and the earliest on September 23. Rainfall during the growing season is adequate to marginal for adapted crops. The average annual precipitation is 19.21 inches. Annual snowfall averages 37.8 inches, which is approximately 3.8 inches of precipitation.

Geology

The subbasin lies within the Western Lake Section of the Central Lowlands Province. Bedrock consists of undifferentiated Precambrian igneous and metamorphic rocks overlain by undifferentiated Cretaceous deposits of the Dakota Group in the northeastern portion of the subbasin. The remainder of the area is overlain by the Cretaceous sediments known as the Colorado Group, consisting of shale and thin limestone. A small section of the Pierre Shale is present in the extreme western portion of the subbasin. Pleistocene glacial activity produced three topographic areas in the subbasin. There are gently rolling hills with numerous sloughs and lakes in the southwestern portion of the subbasin. The northwest and eastern half of the area are featureless plains. Glacial drift averaging about 100 feet thick overlies bedrock and consists of successive bands (from the northeast to the southwest) of clay, silt, and sand glacial lake deposits, delta sand and gravel lakeshore deposits, alluvial sediments in floodplains, and till. There is a small area in the southwest corner of the subbasin that consists of glacial Lake Dakota deposits.

Biology

The original vegetation of the subbasin included the Northern Floodplain Forest, Oak Savanna, Bluestem Prairie, and Wheatgrass-Bluestem-Needlegrass Prairie. The Northern Floodplain Forest is still found along the Red River and in certain locations along the floodplains of the Wild Rice River and its tributaries. Principal trees in these areas consist of American elm, basswood, green ash, boxelder, willows, hackberry, and bur oak. The woodlands have been reduced to less than 3,000 acres in the subbasin, which encompasses 1,429,120 acres. Some of the Oak Savanna type may be found in the region where Ransom, Sargent, and Richland counties adjoin; however, the major portion and more representative areas of the Savanna are found in the Sheyenne River Subbasin in the sandy soils of the Delta. This type is composed of scattered areas of woodland, dominated by bur oak, in a rolling upland prairie. The Bluestem Prairie is the Tall Grass Prairie which once covered the Red River Valley. Conversion of this native grassland to tilled farmland has eliminated most of the prairie, except in the Sheyenne National Grassland, which extends into the subbasin in southeastern Richland County. Dominant plants are big bluestem, switch grass, Indian grass, and prairie dropseed. Agricultural development has also removed most of the Wheatgrass-Bluestem-Needlegrass Prairie that formerly occurred in the western portion of the subbasin. This community is also known as the Eastern Mixed-Grass Prairie and is comprised of mid- and short-grasses and forbs. Dominant species consist of tall grama, blue grama, Kentucky bluegrass, June grass, and needle-and-thread (Hanson, 1976; Kuchler, 1964; Nelson, 1964; Seiler, 1973; Stewart, 1975; Wanek, 1965).

Nearly all of the wetlands in the Red River Valley, or Agassiz Lake Plain, have been drained and converted to farmland. Extensive drainage of the wetlands in the drift plain has also occurred in the western and southern portions of the subbasin. Remaining wetlands are confined mainly to the potholes and marshes of the morainic hills, the clayed soils, the scattered lakes of the subbasin, and the streams and their floodplains. Many of these areas are dependent upon snowmelt and precipitation for their water supply, and as a result, available water will fluctuate from

year to year and with the seasons. Wetland types which have been identified in the North Dakota counties of the subbasin include Type 1--seasonally flooded basins and flats, Type 3--shallow fresh marshes, Type 4--deep fresh marshes, and Type 5--open fresh water (Koch, 1975; Soil Conservation Service, 1957, 1958, 1963; U.S. Fish and Wildlife Service, 1979).

Important wildlife habitats in the subbasin are the remaining woodlands, wetlands, and grasslands. The woodlands and brushy areas provide den and nesting sites, territories, winter and escape cover, and winter food for many resident and migratory species in the region. They also furnish a travel corridor for animals through the intensively farmed regions of the subbasin. Forests afford breeding and nesting areas for birds and rank second to wetlands in breeding bird populations, with 336.0 pairs/Km^2. They also provide an important ecotone or "edge" with adjacent habitats such as grasslands, agricultural lands, and aquatic habitats, and in such cases, will contain wildlife representative of the other bordering habitats. Woodlands contain a greater variety of wildlife species than any other major habitat type found in the subbasin. Wetlands furnish breeding, nesting, feeding, and resting areas for waterfowl; breeding and rearing habitat for big and small game, furbearers, and other wildlife such as wading and passerine birds; spawning and nursery areas for fishes and aquatic invertebrates; and a high-yield food source for many resident species. They rank first in breeding bird densities, with 337.0 pairs/Km^2. The native grasslands or prairie, when found in combination with wetland complexes, form a dynamic and diverse ecosystem which supports diverse and abundant populations of birds, mammals, invertebrates and plants. Average breeding bird densities of 142.7 pairs/Km^2 have been recorded in this highly productive community. Because of their importance as habitats for wildlife and the limited areal extent of these communities within the subbasin, there is a need to protect, conserve, and enhance, these areas wherever possible (U.S. Fish and Wildlife Service, 1979, 1980).

The principal big game animal of the subbasin is the white-tailed deer. Populations are high for North Dakota (>1.5 deer/square mile) along the Red River, low in the remaining eastern portion (<0.5 deer/square mile), and moderate (0.5-1.5 deer/square mile) in the western part. Small game mammals include

tree squirrels and the cottontail. Waterfowl production is low (<4.0 breeding pairs/square mile) along the Red River, moderate (4.0-9.0 breeding pairs/square mile) in the central part, and high (>9.0 breeding pairs/square mile) in the western portion. The most common breeding waterfowl are the blue-winged teal, mallard, pintail, gadwall, and northern shoveler (data from the North Dakota Game and Fish Department in U.S. Fish and Wildlife Service, 1979).

The pheasant and Hungarian partridge are the major upland game birds. Pheasant population densities are high throughout the region, with >10.0 hens/square mile, and partridge populations are considered low, with <12 birds/1,000 miles of rural mail route. Sharp-tailed grouse, whose populations are low at <3.0 sharptails/square mile, are also hunted. Typical furbearers are the red fox, mink, raccoon, skunk, beaver, and muskrat. Red fox populations vary from moderately low (5.0-9.0 families/township) in the east to moderately high (9.0-13.0 families/township) in the west (data from North Dakota Game and Fish Department in U.S. Fish and Wildlife Service, 1979). Table 5 gives harvest data in Cass and Richland counties from 1970-1975 for many of the species mentioned above.

Wiehe and Cassel (1977) compiled a report of the known terrestrial vertebrates in the Sheyenne River Subbasin. The following species numbers were ascertained for each major organism group: (1) amphibians--nine species; (2) reptiles--eight species; (3) birds--262 species; and (4) mammals--56 species. The majority of these 335 terrestrial wildlife species will occur either as residents or migrants in the Wild Rice River Subbasin, since the Sheyenne River Subbasin lies immediately to the north. Abundance and number of species in the Wild Rice River Subbasin will differ from those reported in the Sheyenne River Subbasin since the extent of physiographic areas and associated habitats varies markedly between the two subbasins.

Typical amphibians and reptiles include the chorus frog, tiger salamander, and plains garter snake, which will inhabit most available upland and wetland habitats. Characteristic birds consist of the killdeer in croplands, western meadowlark in grasslands, common grackle in shelterbelts, savannah sparrow around wetlands, and yellow warbler in forests. Common to fairly common nongame mammals are composed of the silver-haired bat, Franklin's ground squirrel, Plains pocket gopher, prairie vole, and meadow jumping mouse (Stewart, 1975; Wiehe and Cassel, 1977).

Table 5

HARVEST DATA FOR GAME AND FURBEARING ANIMALS IN CASS AND RICHLAND COUNTIES, WILD RICE RIVER SUBBASIN

Species	Number Harvested[a]					
	1970	1971	1972	1973	1974	1975
Red fox (trapped and hunted)	73 (159)	493 (1,014)	539 (885)	1,149 (2,343)	520 (1,096)	664 (1,356)
Coyote (trapped and hunted)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (2)
Sharp-tailed grouse	0 (172)	0 (312)	0 (57)	158 (95)	0 (0)	79 (48)
Ring-necked pheasant	2,599 (493)	5,615 (893)	2,254 (1,252)	3,308 (1,278)	8,051 (992)	3,570 (727)
Cottontail	3,158 (2,719)	1,954 (2,426)	4,183 (2,532)	2,442 (8,079)	2,316 (2,177)	3,691 (1,712)
White-tailed deer	194 (200)	335 (562)	287 (458)	362 (628)	259 (404)	269 (417)
Hungarian partridge	113 (794)	1,272 (1,018)	754 (1,831)	1,144 (3,050)	5,230 (3,147)	1,198 (1,390)
Fox squirrel	3,972 (3,412)	2,627 (3,434)	5,050 (3,260)	2,195 (5,290)	3,339 (3,588)	2,970 (1,659)

[a]Numbers in parenthesis are for Cass County; those outside of parenthesis are for Richland County.

Source: North Dakota Game and Fish Department, 1979.

The Wild Rice River and its major tributary, Antelope Creek, drain a combined total area of 2,233 square miles. Several small low-water dams and a few larger impoundments have been constructed on the river and its tributaries. Channelization, streambank clearing, and agricultural and feedlot runoff have caused degradation of the river's water quality (U.S. Fish and Wildlife Service and North Dakota Game and Fish Department, 1978; Task Force I Report, Wild Rice River Subbasin).

From its headwaters in Sargent County to Lake Tewaukon, the Wild Rice River is considered to be a Class I stream with the highest value fishery resource. This critical evaluation is given to this reach not because of its stream fisheries, which only provide moderate amounts of northern pike, yellow perch, crappie, and several species of forage fish, but rather for the highly productive lakes located along the reach. These lakes (Silver, Sprague, and Tewaukon) provide a high-valued sport fishery for bluegill, walleye, crappie, yellow perch, and northern pike. Some of these lakes have also been commercially harvested for carp and bullheads in conjunction with the Game and Fish Department's rough and forage fish removal program. These lakes and their adjacent wetlands are also heavily utilized by waterfowl. The Wild Rice River from Lake Tewaukon to its mouth at the Red River of the North has been designated by the North Dakota Game and Fish Department (1978) as a high priority (Class II) stream that provides moderate sport and forage fish production. Antelope Creek has been evaluated as a Class III stream that has a substantial fishery resource. This reach maintains a moderate production of sport and forage fishes. The creek's value has been reduced because of its degraded water quality, due to the problems discussed in the preceeding paragraph (U.S. Fish and Wildlife Service and North Dakota Game and Fish Department, 1978).

Other game fish that occur within the subbasin, besides those already mentioned, include channel catfish, sauger, goldeye, pumpkinseed, and other sunfishes. Rough and forage fishes common to the subbasin include fathead minnow, common white sucker, bigmouth buffalo, brook stickleback, and carp (Copes and Tubb, 1966). Several of these species occur only during the spring runoff. Some are stranded in a few isolated pools after the runoff and are then subjected to winterkill (Task Force I Report, Wild Rice River Subbasin, no date).

Cvancara (1970) reported only two mussel species that were represented by live specimens from the subbasin. These were Amblema lostata and Anodonta grandis. Two other species, Lasmigona complanta and Lampsilis siliquoidea, were represented by only empty shells.

Water Supply

Twelve communities in the subbasin have municipal water supplies and, with the exception of Britton, South Dakota, all depend on groundwater. One of the major towns in North Dakota, Hankinson, uses approximately 63,875,000 gallons of water annually, according to the North Dakota State Department of Health. The city of Britton, South Dakota relies on the White Lake for water supply during the summer months. The rest of the year groundwater is used from a recently built well. The groundwater, compared to White Lake, is of a much softer quality and is less expensive to manage. Farmers in the nearby area also use the ground well for irrigation of crops. There is one industry in the town, Horton Industry, which uses a sizable amount of water.

Water Quality

Table 6 presents surface water quality data from the Wild Rice River at three stations. The data listed indicate that high TDS concentrations occur throughout most of the year. The greatest TDS levels occur during the winter months when there are prolonged periods of low or zero flow. Municipal effluent and agricultural runoff have degraded the water quality in the river and accelerated the eutrophication process in numerous lakes within the subbasin. The river's water is also characterized by high concentrations of sulfates and hardness (U.S. Geological Survey, 1979; Upper Mississippi River Basin Commission, 1977).

The aquifers within the subbasin normally produce waters with TDS concentrations exceeding the acceptable limits of 1000 mg/l. Cogswell's water supply contains fluoride concentrations that are well over 1.0 mg/l. These excessive concentrations create a mottling of tooth enamel. Several communities' supplies contain high levels of iron and manganese (Souris-Red-Rainy River Basins Commission, 1972). Table 7 presents data from eight municipal water supplies within the subbasin.

Table 6

SURFACE WATER QUALITY FROM THREE STATIONS ALONG THE WILD RICE RIVER, OCTOBER, 1977 TO SEPTEMBER, 1978

Parameter	Standard[1]	Abercrombie		Rutland*	Cayuga*
		Minimum	Maximum		
Streamflow (cfs)		2.3	4,670	368	245
pH (Standard Unit)	6-9	7.0	8.2	7.2	7.5
Temperature (^{o}C)	32	0.0	26.0	6.0	9.5
Hardness ($CaCO_3$)	-	220	750	88	91
Sodium (Percent)	60	19	26	9	13
Sulfate	-	110	460	37	30
Chloride	250	16	59	7.8	5.7
Fluoride	-	0.2	0.4	0.1	0.1
Total Dissolved Solids (TDS)	1,000	377	1,310	135	133
Nitrates (N)	5.0	0.0	0.46	-	-
Boron (mg/l)	500	130	330	180	140
Iron (mg/l)	-	110	-	40	100

*Only one sample was collected at this site (March, 1978).

Note: Unless otherwise stated all units of measure are in milligrams per liter (mg/l).

Source: U.S. Geological Survey.

Table 7

GROUNDWATER QUALITY OF EIGHT COMMUNITIES WITHIN THE WILD RICE RIVER SUBBASIN

Parameter	Cogswell*	Forman*	Gwinner*	Hankinson*	Lidgerwood*	Mooreton	Rutland	Wyndmere
pH	8.2	8.3	7.5	7.4	8.3	7.6	8.2	8.2
Hardness ($CaCO_3$)	70	520	885	320	400	260	315	535
Sodium	740	290	235	5	220	705	194	67
Sulfates	1,100	775	780	TRACE	450	1,150	275	173
Chloride	275	74	25	TRACE	4	305	26	0
Fluoride	3.6	0.2	0.4	0.2	TRACE	2.2	0.5	0.3
TDS	2,429	1,449	1,884	432	1,285	2,583	1,050	1,030
Nitrates	TRACE	4	11	TRACE	44	5	9	-0-
Iron	1.6	0.3	0.9	0.6	0.3	0.0	0.2	TRACE
Manganese	0.0	1.0	0.7	0.2	0.0	0.0	TRACE	TRACE

*Represents only one well out of two or more.

Note: pH is measured in standard units, others in milligrams per liter (mg/l).

Source: North Dakota State Department of Health, 1964.

Aesthetics

The subbasin is characterized by level terrain in the eastern section which rises gradually in the central and southwestern portions. The morainic hills offer many lakes and wooded areas that provide important wildlife habitat and increase the aesthetic appeal of the subbasin. The Silver Lake Recreation Area provides residents with diverse recreational opportunities. The small portion of the Sheyenne National Grasslands near Hankinson offers an opportunity to view one of the few remaining areas of natural grasslands that once characterized the prairie region. The area also provides habitat for a significant portion of the state's remaining population of prairie chickens.

Cultural Elements

Paleo-Indian occupation of much of the eastern portions of the subbasin was probably impossible before 9000-7000 B.P. Prior to this date, much of the glacial Lake Agassiz plain remained poorly drained, perhaps swampy, and certainly inhospitable to early man. Parts of the subbasin are still characterized by areas of large swamps, low swales, and potholes which have no well-established drainage system. Recent archeological investigations in the Wild Rice vicinity have centered upon Lake Tewaukon (Good et al., 1977:220-231). This survey found no surface indications of archeological sites along selected portions of the Wild Rice River, although three archeological sites were recorded along the shores of Lake Tewaukon. Most of the material recovered indicates late prehistoric, protohistoric and some historic occupation of the lake area (Good et al., 1977:222)

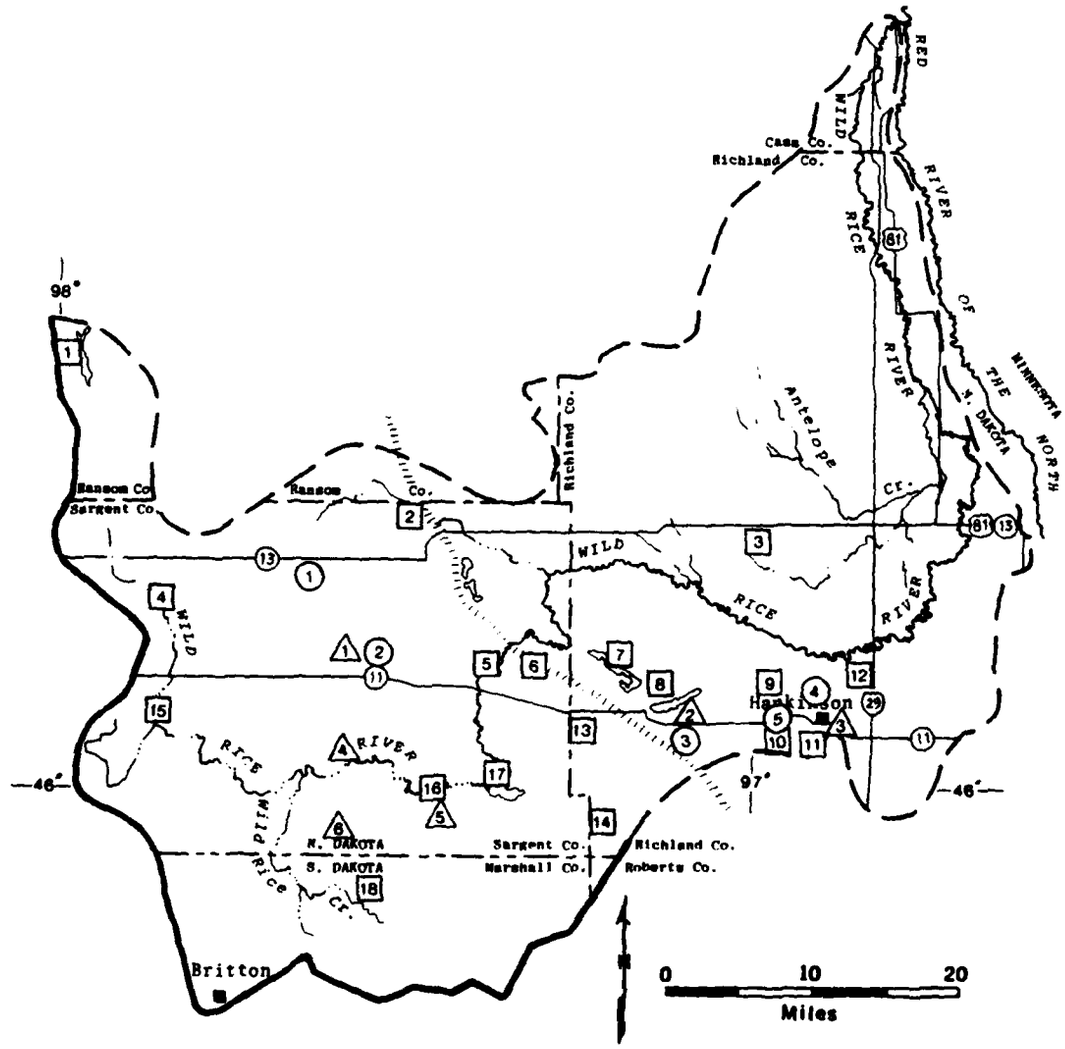
In the absence of other archeological data specifically about the subbasin, it is necessary to make some generalizations based upon knowledge of archeology outside the immediate area. Probable areas for prehistoric-historic archeological sites in the subbasin might include lakes, beach ridges, intermittent streams, the Wild Rice River, and the emminences which overlook parts of the river valley. The apparent, or expected, association of archeological resources with major streams and tributaries could have a significant impact upon the implementation of flood control alternatives.

The subbasin was occupied by several related groups of native Americans during proto-historic and historic times. The Cheyenne Indians are known to have resided in the Sheyenne River area, and they probably exploited parts of the subbasin during their migration westward between 1700-1752. The Yanktonai (Dakota) controlled the subbasin during the period of white contact, but the Sisseton and Wahpeton and Santee Sioux established a reservation in the nearby Lake Traverse-Minnesota River area during the mid-19th century. Many of these people were relocated to North Dakota following the Sioux Uprising of 1862 (Blegen, 1963:264-66; 167-68). In May of each year, the Teton Sioux conducted a trade fair with their Yanktonai relatives along the Upper James River, just outside of the subbasin. It can be seen then that in historic times, the subbasin vicinity comprised part of a frontier between the eastern Sioux, their western tribes, and the agricultural villages along the Upper Missouri.

By 1869-70, the settlement of the subbasin by Euro-Americans began to crest as transportation networks and military posts heightened the population flows. Many of the pioneers were of German and Norwegian extraction, and most had immigrated from homesteads in Minnesota, Wisconsin, and Iowa (Robinson, 1966:130-31). There are currently two historical sites listed on the National Register of Historic Places in the subbasin. Additional surveys will probably identify other significant prehistoric and historic resources in the subbasin.

Recreation Resources

Water-related recreation resources are fairly abundant, and hunting and fishing resources are excellent in the central and western portions of the subbasin. There are approximately 16,161 acres of recreational lands in the subbasin. One National Wildlife Refuge is owned in fee title for a total of about 6,864 acres. In addition, there are approximately 2,192 acres of privately owned easement refuges. The easements provide for the impounding of water and restriction of hunting only. State Wildlife Management areas total approximately 5,895 acres. The distribution of the subbasin's recreational areas, as illustrated in Figure III, basically conforms to the topographical pattern of the area. Most of the sites are located in the morainic hills of the southwestern portion of the



WILDLIFE MANAGEMENT AREAS

1 Englevale Slough WMA
2 Storm Lake National Wildlife Refuge
3 Mooreton Pond WMA
4 Crete Slough WMA
5 Wild Rice National Wildlife Refuge
6 Krause Slough WMA
7 Wild Rice National Wildlife Refuge
8 Swan Lake WMA
9 Slack Slough WMA
10 Lake Elsie National Wildlife Refuge
11 Mud Lake WMA
12 Sheyenne National Grasslands
13 Grant Township WMA
14 Park Lake WMA
15 Meszaros Slough WMA
16 Lake Tewauken National Wildlife Refuge
17 Tewauken WMA
18 Douglas Game Production Area

EXISITNG RECREATION AREAS

1 Forman Park
2 Lidgerwood Park
3 Hankinson Park
4 Silver Lake Recreation Area
5 Frenier Dam
6 Havana Park

OTHER EXISITNG RECREATION AREAS

1 Gwinner Golf Course
2 Sargent County Fairgrounds
3 Lidgerwood Golf Course
4 Hankinson Golf Course
5 Hankinson Snowmobile Club

Source: Gulf South Research Institute.

Figure III. RECREATIONAL RESOURCES

subbasin. An inventory of facilities for areas larger than 15 acres, which comprise 99 percent of the total recreational acreage, is presented in Appendix B of this report.

Hunting opportunities are abundant in the subbasin as illustrated by one national wildlife refuge and 13 state wildlife management areas. A small portion of the Sheyenne National Grasslands is located in the subbasin, but total recreational acreage does not include this area. The most common species found in the subbasin include white-tailed deer, squirrel, pheasant, sharp-tailed grouse, and fox. Waterfowl production areas are open to hunting and trapping.

There are very productive fishery resources in the chain of lakes associated with the upper reaches of the Wild Rice River in the western portion of the subbasin. The lakes, particularly Silver, Sprague, and Tewaukon, are noted for walleye, crappie, perch, and northern pike. The fishery value of the Wild Rice River, downstream from Lake Tewaukon, gradually increases as the river approaches the confluence of the Red River of the North.

The most important water-based recreation facility in the subbasin is the Silver Lake Recreation Area, consisting of 210 acres offering camping, picnicking, and swimming opportunities that are lacking in many other subbasins of the Red River Basin.

Proposed recreational sites identified in the subbasin include a segment of the North Country National Scenic Trail through Richland County and the expansion of existing facilities at several municipal and county parks. These areas provide subbasin residents with non-water-based recreational activities.

Significant Environmental Elements

Social

There are 21 towns with a total population of 8,083, representing 46 percent of the subbasin population. There are no major urban centers, and the two largest population centers are Hankinson, with 1,042, and Britton, with 1,496. Two Soil Conservation Service flood control projects have contributed to significant reductions in flooding in the southern portion of the subbasin, including the town of Britton. The town of Hankinson,

however, remains subject to flooding problems. Problems for towns in the subbasin as a result of flooding include damages to residential and commercial areas, transportation facilities, and utilities.

The eastern portion of the subbasin is primarily agricultural lands that are affected by recurring flooding problems. Damages to farmstead structures and equipment and delays in planting or loss of mature crops result from floods. The small towns in the subbasin function as agricultural service centers and may experience indirect economic effects as a result of economic losses caused by flooding in the agricultural areas.

Cultural

Assessment of significant cultural elements in the subbasin is impossible without more complete information. Only selected portions of the subbasin have been systematically surveyed at present. There are two sites listed on the National Register of Historic Places, and other potentially eligible cultural resources are likely to be identified in the future.

Soils

The subbasin varies from the rolling glacial drift prairie in the west to the nearly level glacial lake plain in the east. The eastern portion of the subbasin was once covered by Lake Agassiz and is now part of the Red River Valley. Most soils were formed in lacustrine deposits of sand, silt and clay. The fertile heavy soils are often difficult to work. Some parts of the area are so nearly level that surface drainage is restricted. An extensive area of sandy soils has formed on the beach lines and the Sheyenne Delta deposits.

The glacial Lake Dakota area is located in the western part of the subbasin and consists of soils developed in sandy material. It includes, however, soils in glacial deposits of silt and clay and soils in loam underlain by sand, gravel, or both. The drainage pattern is not well developed, and a high groundwater table underlies much of the area.

The drift prairie soils are loams and clay loams, but because of greater erosion in the more rolling topography, soils are generally thinner than on the lake plain.

Water

Approximately 3.7 percent of the total land area of the subbasin is occupied by water. The streams and lakes in the subbasin are important for recreation, water supply, and fish and wildlife.

Woodlands

The woodlands and brushy areas of the subbasin are significant because of their importance as wildlife habitats and because of their limited areal extent. Land use data show that only 0.2 percent (2,858 acres) of the total subbasin area (1,429,120 acres) is forested. There is an apparent need to protect, conserve, and enhance this major wildlife habitat type in the subbasin.

Wetlands

The wetlands of the subbasin are important because of their many functional uses and values such as waterfowl production areas, habitats for flora and fauna, water storage capacity during spring runoff and periods of extreme precipitation, groundwater recharge, and sediment and nutrient traps (Cernohous, 1979; U.S. Fish and Wildlife Service, 1979; E.O. 11990, dated 24 May 1977). Like the woodlands, they are also significant because their number and areal extent have decreased in favor of agricultural development and other land uses.

Table 8 gives the number and areal extent of wetlands in the North Dakota counties included by the subbasin. The figures were obtained during a 1964 inventory based on a 25 percent sampling of the wetlands within these counties. More recent information is not available. The number and acreages of all Type 3, 4, and 5 wetlands are multiplied by four to expand the 25 percent sample to 100 percent. Type 1 wetlands were not measured in the 1964 survey. The number and acreages of Type 1 wetlands, however, were estimated based on previous studies, which indicated that they comprise about 60 percent of the total wetland numbers and 10-15 percent of the total wetland acres in the Prairie Pothole Region. Although no acreage figures are available for wetlands drained and converted to cropland, most have been drained in eastern North Dakota. Current annual wetland drainage estimates are thought to be less than two percent of the remaining wetland base, except in isolated areas where they may be higher (U.S. Fish and Wildlife Service, 1979).

Table 8

1964 WETLAND INVENTORY DATA FOR THE NORTH DAKOTA COUNTIES INCLUDED BY THE WILD RICE RIVER SUBBASIN

County	WETLAND TYPES[a] 1 Number[b]	1 Acres[c]	3 Number	3 Acres	4 Number	4 Acres	5 Number	5 Acres	TOTAL Number	TOTAL Acres
Cass	411	414	646	1,938	39	823	-0-	-0-	1,096	3,175
Richland	1,087	2,949	1,464	4,465	316	10,592	32	4,600	2,899	22,606
Ransom	2,641	2,271	4,046	8,335	340	4,695	16	2,112	7,043	17,413
Sargent	5,953	6,391	8,987	17,295	911	18,439	24	6,872	15,875	48,997
TOTAL	10,092	12,025	15,143	32,033	1,606	34,549	72	13,584	26,913	92,191

[a]Type 1 - Seasonally flooded basins and flats
Type 3 - Shallow fresh marshes
Type 4 - Deep fresh marshes
Type 5 - Open fresh water

[b]Calculated at 60 percent of total wetland numbers.

[c]Calculated at 15 percent of total wetland acres.

Source: U.S. Fish and Wildlife Service (1979).

As of 1964, a total of 26,913 wetlands accounting for 92,191 acres remained within the four counties encompassed by the subbasin's limits.

Grasslands

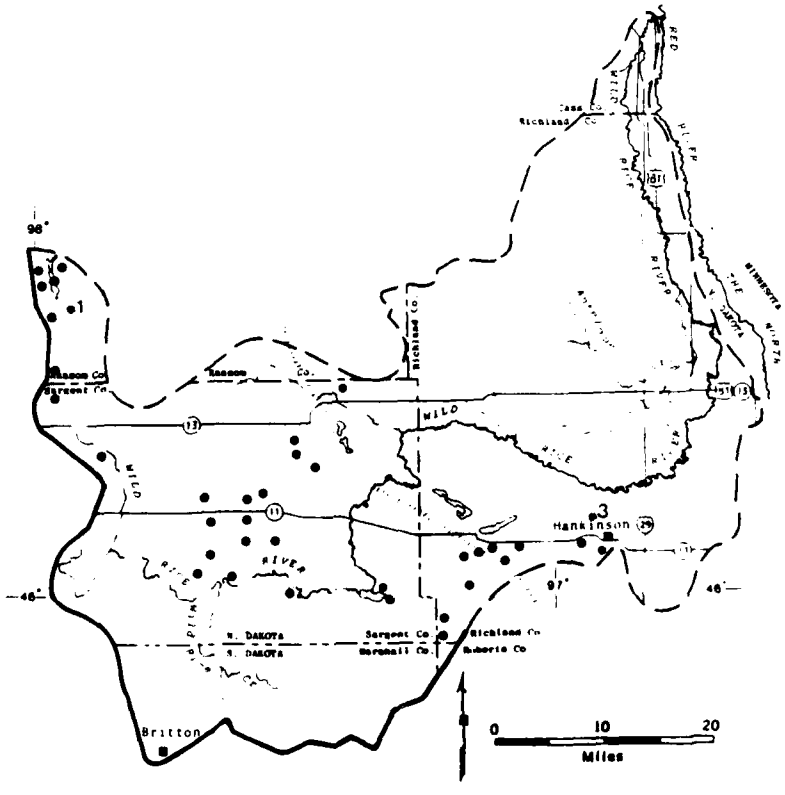
As with the woodlands and wetlands, the remaining native grasslands of the subbasin are significant because of their value as wildlife habitats and because they have been diminished substantially through conversion to agricultural and other land uses. Part of the Sheyenne National Grasslands, which still harbors tracts of the original prairie communities, extends into the subbasin in Richland County and provides protection for the unique prairie ecosystem. The need exists to protect, conserve, and enhance wherever possible the native grasslands of the subbasin.

Waterfowl Production Areas

Waterfowl Production Areas (WPAs) are wetland areas that the U.S. Fish and Wildlife Service (USFWS) has either acquired through fee title, or obtained an easement interest in, to preserve valuable breeding, nesting, and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of Migratory Bird Hunting and Conservation Stamps ("Duck Stamps"). These WPAs are significant because they provide the public with a great variety of wildlife-oriented recreational opportunities as well as provide valuable habitat for migratory waterfowl and many other forms of wildlife. The USFWS is responsible for the compatibility determinations (uses) and the issuance and denial of permits involving these lands. WPA's acquired in fee title are managed for optimum wildlife production, particularly waterfowl; on easement WPA's the rights acquired are limited to the burning, draining, and filling of wetland basins and right of access. All other property rights remain with the landowners. The approximate locations of the WPAs acquired in fee within the subbasin are shown in Figure IV. Total acreage of these WPA's, fee and easement, included in the subbasin are listed in Table 9.

Wildlife Management Areas

Thirteen wildlife management areas are situated within the subbasin. A list of these areas and their acreages and locations were presented



● NATURAL AND SCIENTIFIC AREAS

● WATERFOWL PRODUCTION AREAS (Fee Tracts)

*Exact locations and numbers of waterfowl production areas are on file at the U.S. Fish and Wildlife Service, Area Office, Bismark, North Dakota. No copies of these maps have been published or released but can be reviewed at the above office.

Source: State Comprehensive Outdoor Recreation Plan, 1975.

Figure IV. WATERFOWL PRODUCTION AREAS AND NATURAL AND SCIENTIFIC AREAS

Table 9

WATERFOWL PRODUCTION AREAS (WPAs) AND WETLAND EASEMENT AREAS OF THE COUNTIES INCLUDED IN THE WILD RICE RIVER SUBBASIN

County	WPAs (Acres)	Wetland Easement Areas (Acres)	Total
Ransom	4,153	18,364	22,517
Richland	4,204	416	4,620
Sargent	3,537	11,848	15,385
TOTAL	11,894	30,628	42,522

Source: U.S. Fish and Wildlife Service Fee and Easement Interests in Real Property, 1979.

in the Existing Conditions section for recreation. These areas are significant because of the opportunities provided for outdoor recreation and the protection and management given to biological resources within their confines. Included in these areas is the Lake Tewaukon area, which is managed for waterfowl production by the U.S. Fish and Wildlife Service and the North Dakota Game and Fish Department.

Threatened or Endangered Species

The American peregrine falcon and northern bald eagle are endangered birds that are presumed to occur within the subbasin. Although no recent breeding records of either bird have been reported from the subbasin, the subbasin is within the species' migratory patterns. Illegal hunting, loss of habitat, and the early widespread use of DDT and its derivitives resulted in the drastic decline in the populations of both species (McKenna and Seabloom, 1979). One of the largest stable populations of the greater prairie chicken is found on the Sheyenne National Grasslands in portions of Richland, Ransom, and Sargent counties. This community is unique since it is the only population of prairie chickens in North Dakota that is steadily increasing (U.S. Fish and Wildlife Service, 1978).

Other Important Species

Three animal species that occur within the subbasin are considered to be of special interest because they are peripheral species: (1) prairie

skink, (2) pileated woodpecker, and (3) plains pocket mouse. The prairie skink has been reported from Richland and Sargent counties where it is restricted to open, grassy areas with soft, sand soil. The soft soil is necessary to allow the skink to burrow deep enough to survive the winter. The pileated woodpecker prefers extensive stands of coniferous or mixed forests. This bird has been reported from the forested borders along the Red River and its major tributaries. The plains pocket mouse is sparsely distributed throughout southeastern North Dakota. This small mammal inhabits prairies with sandy soils (McKenna and Seabloom, 1979). The trout-perch, a rare fish species, was reported by Copes and Tubb (1966) from the subbasin.

Rare and Unique Plants

Barker et al. (1976) compiled a list of rare and unique plants found in North Dakota by studying the distribution records of the plant collections in the North Dakota State University Herbarium. A species was considered rare if only a few individuals were recorded in three or less counties. If there were many widespread individuals reported from no more than three counties, the species was considered unique. Several rare and unique plants have been reported from the subbasin. These plants are listed with their respective habitats and status in Table 10.

Natural Areas

Three natural and scientific areas are located within the subbasin: (1) Englevale Slough, (2) Havanna Prairie, and (3) Hankinson Dunes. The Englevale Slough (Ransom County) is a 700-acre tract of highly productive marshlands. This area is heavily utilized by migrant waterfowl. The Havanna Prairie (Sargent County) is the largest remaining tract (2,097 acres) of prairie in the Coteau des Prairies in North Dakota. Within this prairie is located a 40-acre wooded ravine known as the Red Elm Ravine. This area supports rare and unique species such as Dutchman's breeches and various ferns. The Hankinson Dunes (Richland County) is a 2,700-acre tract of sandy prairie with scattered aspen groves (Kantrud, 1973). The approximate location of these natural areas is shown on Figure IV.

Table 10

RARE AND UNIQUE PLANTS OF THE WILD RICE RIVER SUBBASIN

Common Name	Status	County	Habitat
Adder's Tongue Fern	Rare	Richland	Prairie meadows and woodlands
Spiny Naiad	Rare	Richland	Submerged aquatic in Lake Elsie
Slippery Elm	Unique	Sargent	Rich, wooded areas
Blue Cohosh	Rare	Richland	Rich, moist woods
Dutchman's Breeches	Rare	Sargent	Rich, wooded area
Illinois Bundleflower	Rare	Sargent	Sandy soil along lakes
Canada St. John's Wort	Rare	Richland	Wet meadows
Waterwort	Rare	Cass	Shoreline of streams, ponds, and lakes
Mountain Mint	Rare	Richland	Moist prairie
Silky Aster	Unique	Richland	Upland prairie
Annual Fleabane	Rare	Sargent	Moist woodlands
Boneset	Unique	Richland	Wet meadows; along margins of ponds and lakes

Source: Rare and Unique Plants of North Dakota, no date.

V. FUTURE CONDITIONS

V. FUTURE CONDITIONS

The following description of the subbasin's "most probable" and "without project" future conditions and resources focuses on economic aspects, population projections, and generalized environmental conditions and resources.

Most Probable Economic Conditions

According to the Principles and Standards, specifications of future conditions should reflect OBERS Series E and E' projections as a basis, unless conditions unique to the study area dictate that OBERS may not be totally satisfactory. Projections of general economic and demographic indicators for the non-SMSA portions of the Fargo-Moorhead area appear to be underestimated, since they project steady decreases throughout the study period. Therefore, Gulf South Research Institute (GSRI) developed figures have been adopted as most probable. OBERS E and E' projections have, however, been designated as most probable for per capita income and future agricultural activities.

Data presented in Table 11 depict population, employment, and per capita income (expressed in 1979 dollars) figures. These figures reflect the slight decline and then slow reversal during the past decade of population and employment trends. This minor reversal has resulted largely from the stabilization of agricultural employment. Per capita income is forecast to rise at the rate set for the non-SMSA portion of the Bureau of Economic Analysis (BEA) area; i.e., some three percent per annum. The Lake Agassiz Regional Council identified the town of Hankinson as a full convenience center for the south Richland County area, and this role is anticipated to continue.

Most Probable Agricultural Conditions

Approximately 1.1 million acres are currently under cultivation in the subbasin, and wheat, sunflowers, corn, and barley are the principal crops produced. Estimated value of the total production of the four principal crops for 1980 is $79.1 million (using October 1979 Current Normalized Prices for North Dakota). Projections of total production

Table 11

WILD RICE RIVER SUBBASIN, POPULATION, EMPLOYMENT, AND PER CAPITA INCOME PROJECTIONS, 1980-2030

Parameter	1970	1977	1980	1990	2000	2010	2020	2030
Population	17,937	17,469	17,500	17,600	17,800	18,000	18,100	18,200
Employment	6,099	8,210	8,200	8,300	8,400	8,500	8,600	8,700
Per Capita Income (Dollars)	$4,949	$5,841	$7,400	$9,600	$12,500	$16,200	$21,000	$26,500

Sources: U.S. Water Resources Council, 1972 OBERS Projections, Series E; and Gulf South Research Institute.

through 2030 for these principal crops are presented in Table 12. The projected total production of these principal crops for the year 2030 is valued at $132.9 million (using October 1979 Current Normalized Prices for North Dakota).

Evaluation of Flood Damages--Future Conditions

A summary of present and future average annual flood damages is presented in Table 13. Assuming a discount rate of 7 1/8 percent, average annual equivalent flood damages are $771,100. Crop damages dominate the picture, accounting for 74 percent of this figure.

Flood damages to residences, businesses, industrial structures, churches, schools, automobiles, house trailers, public property and contents are included in the urban damages category. Damages to streets and utilities (including water, gas, electricity, sanitary sewers, storm sewers, and telephone systems) are also taken into consideration. This category also includes loss of wages, loss of profits, expenditures for temporary housing, cleanup costs, and extra expenses for additional fire and police protection and flood relief.

Agricultural flood damages consist of crop and pasture damage, which may include costs of replanting, refertilizing, additional spraying, reduced crop yields, loss of animal pasture days, and other related flood losses.

Other agricultural damages consist of land damage from scour and gully erosion and deposition of flood debris; livestock and poultry losses; damages to machinery and equipment, fences, and farm buildings and contents (excluding residences); and damages to irrigation and drainage facilities.

Transportation damages include all damages to railroads, highways, roads, airports, bridges, culverts, and waterways not included in urban damages. In addition, all added operational costs for railroads and airlines and vehicle detours are included.

Future growth of urban flood damages was estimated to be an uncompounded (straight-line) rate of one percent per year for a 50-year period beginning in the base year, with no growth thereafter.

Table 12

WILD RICE SUBBASIN, PRINCIPAL CROPS AND PROJECTED PRODUCTION 1980-2030
(Production in Thousands)

Year	Wheat (Bushels)	Sunflowers (Pounds)	Corn (Bushels)	Barley (Bushels)
1980	7,721	228,227	11,611	4,406
1990	8,957	264,743	13,468	5,111
2000	10,192	301,260	15,326	5,816
2010	10,964	324,083	16,487	6,257
2020	11,736	346,905	17,648	6,698
2030	12,972	383,422	19,506	7,403

Sources: OBERS Series E'; and Gulf South Research Institute.

Agricultural crop flood damages were projected to increase at the same rate as crop income projections published in the 1972 OBERS Series E projection report. These crop income projections were prepared by the U.S. Economic Research Service (ERS) for the Red River of the North region. Other agricultural flood damages were projected to increase at one-half of this rate.

Transportation damages are not expected to change throughout the project life because of the long-term economic life associated with such structures as bridges, railways, roads, and culverts. In addition, it has been found that repairs to these types of structures rarely exceed the cost of a new structure, even with frequent flooding.

Most Probable Environmental Conditions

Improvements in water quality will occur with successful implementation of point and nonpoint source pollution abatement programs. The nonpoint source program will take substantially longer to implement. These improvements will benefit aquatic biota, as well as wildlife that utilize aquatic habitats.

Table 13

WILD RICE RIVER SUBBASIN, SUMMARY OF PRESENT AND FUTURE AVERAGE ANNUAL DAMAGES, URBAN, AGRICULTURAL, AND TRANSPORTATION
(October, 1979 Prices, 7 1/8 Percent Interest)

Category	Flood Damages						Increase 1980-2030	Average Annual Equivalent Factor	Average Annual Equivalent of Increase	Equivalent Average Annual Damages
	1980	1990	2000	2010	2020	2030				
Urban	*	*	*	*	*	*	*	*	*	*
Agricultural										
Crop	$476,500	$552,700	$629,000	$676,600	$724,300	$ 800,500	$324,000	0.2903	$ 94,100	$570,600
Other Agricultural	158,800	171,500	184,200	192,100	200,100	212,800	54,000	0.2903	15,700	174,500
Transportation	26,000	26,000	26,000	26,000	26,000	26,000	--	--	--	26,000
TOTAL	$661,300	$750,200	$839,200	$894,700	$950,400	$1,039,300	$378,000	0.2903	$109,800	$771,100

*Average annual urban damages were reported to be minor for the Wild Rice River Subbasin in the Red River of the North Basin Plan of Study, April, 1977.

Source: Gulf South Research Institute.

However, periodic problems with zero and low stream flow are expected to continue to restrict the fisheries of the subbasin.

Both native woodlands and wetlands are expected to decline even further through conversion of these lands for agricultural development and other uses. Woodland losses may be offset to some degree, however, with shelterbelt, windbreak, and greenbelt plantings through such programs as 208 planning. These plantings may or may not be of comparable quality. Decreases in these habitats will result in diminishing plant and animal populations that depend wholly or in part upon these environs.

Without Project Conditions

In the absence of a plan to alter resource management procedures, it is anticipated that the conditions that will prevail between 1980 and 2030 will be the same as those described as being the most probable.

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

Institutions

The development of effective water resources management practices in the subbasin is affected by a large number of Federal, state, and local agencies involved in project planning and implementation. There are 44 Federal agencies with various types of jurisdictions, and 14 directly involved in the water and related land resource planning process. At the state level, seven agencies are involved. There are also regional commissions, county agencies, and municipal entities. Differences in perspective and problems of coordination hamper the effective and speedy resolution of problems.

The Wild Rice Subbasin is limited in the development of an efficient water resources management program by the overlapping jurisdictional problems resulting from numerous agencies with authority in the subbasin and the lack of an overall plan that encompasses the entire area. There are four water management districts representing southeast Cass County and Richland, Sargent, and Ransom counties in the North Dakota portion of the subbasin. The water management districts have broad powers relating to water resource development, including flood control. water supply, water conservation, and other related water problems. County commissioners for the two South Dakota counties in the subbasin serve the same function as the North Dakota water management districts.

The southeast Cass water management district and the South Dakota portion of the subbasin are included in water management plans for those areas; however, the remaining counties have not developed overall plans. There is no plan that approaches flooding problems in the subbasin with an overall perspective. There are also soil conservation districts representing each county with jurisdiction in the subbasin.

The major Federal agencies with water resource development interests in the area are the Soil Conservation Service (SCS) and the Corps of Engineers. The Corps of Engineers has not developed any flood control measures in the subbasin; SCS has completed two projects since 1968.

The Corps of Engineers, SCS, the State Water Commission, the water management districts, soil conservation districts, and county commissioners in South Dakota, and the town of Hankinson should be consultea in further flood control planning in the subbasin. In addition, a portion of the Sisseton Indian Reservation is included in the subbasin. The Sisseton Reservation Tribal Council and the Bureau of Indian Affairs should also be consulted.

It should be noted that the subbasin is included in the Lake Agassiz Regional Council planning district. A comprehensive land use plan has been developed that includes the subbasin.

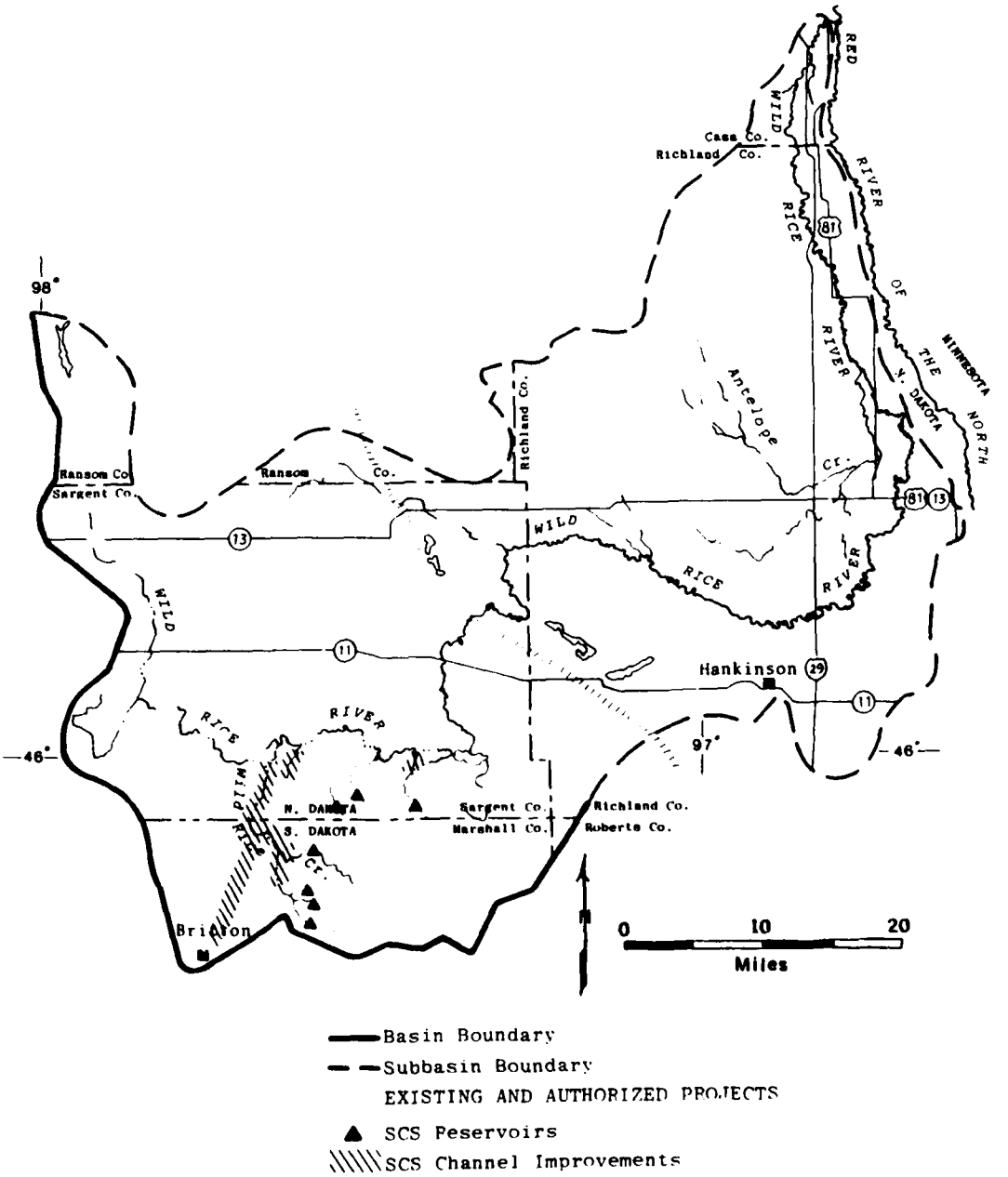
Structural Measures

There have been numerous private and legal drains constructed in the Wild Rice Subbasin. The Corps of Engineers has no existing or authorized projects in this subbasin. Under the authority of Public Law-566, the Soil Conservation Service (SCS) in cooperation with local interests has completed two floodwater control and agricultural management (drainage) projects. The locations of structural measures included in these projects are shown in Figure V and include the following:

1. The Tewaukon Watershed Project was completed in 1968 and included both land treatment and structural measures for flood control and prevention. Structural measures include three floodwater retarding structures, with a total flood storage capacity of 3,000 acre-feet, and 9.2 miles of floodways and channel improvements. This project provides 10 percent (10-year) flood protection for this 147 square mile watershed.

2. The Wild Rice Creek Watershed Project was completed in 1971 and also included land treatment and structural measures for flood control and prevention. Structural measures include four floodwater retarding structures and 24.5 miles of floodways and channel improvements. The four floodwater retarding structures are all located in the South Dakota portion of the watershed and have a total flood storage capacity of about 2,235 acre-feet. This project provides 10 percent (10-year) flood protection for this 365 square mile watershed.

In addition to these projects, planning has been suspended or terminated for three other watershed projects. The planning study for the Storm Lake-Elk Creek Watershed Project revealed that the flood prone area was not extensive, and an economically feasible plan could not be formulated;



Source: Gulf South Research Institute.

Figure V. EXISTING FLOOD CONTROL MEASURES

therefore, the project was terminated in 1961. Planning for improvements in the Veblen Watershed was terminated in 1961. This project was terminated because of inadequate floodwater storage sites, and sponsors and landowners were not receptive to local costs and mitigation features. Further planning in the Wild Rice "B" Watershed Project was terminated because sponsors were unable to obtain the necessary land rights. In 1975, the Corps of Engineers made a reconnaissance study for clearing and snagging the lower 19.4 miles of the Wild Rice main stem channel which revealed that this project was not economically feasible.

Nonstructural Measures

Nonstructural flood control measures are measures that reduce or eliminate flood damages through procedures that involve little if any construction efforts. Typically, these types of measures will include flood warning and emergency protection, floodplain zoning and regulation, flood insurance, flood proofing and floodplain evacuation. These measures are primarily applicable to urban areas.

Average annual urban damages are reported to be minor, and existing information indicates that substantial urban flood damages are not probable in the subbasin.

The towns in the subbasin participate in the Red River Valley flood warning system. The flood warning system for the Red River Valley is a cooperative network organized by the National Weather Service in Fargo, North Dakota. Fifty volunteers throughout the basin report to the National Weather Service on a weekly basis during winter and fall and on a daily basis during spring and summer. The reportage covers all precipitation of 0.1 inch or more, including amounts of snow and water equivalent. This information is transmitted to the River Forecasting Center in Minneapolis, where it is run through a computer system to determine probable flood stages. The predictions are then transmitted to the National Weather Service in Fargo, which releases them to the public through the news media. Communities are then able to engage in emergency actions to protect themselves from flood damages. Contacts with local officials indicate the flood warning system generally works quite well in the subbasin.

Floodplain regulation and flood insurance are currently required by Federal policies and encouraged by the State of North Dakota. Floodplain regulation is the regulation of any new developments in existing floodplain areas, thereby preventing or reducing future flood damages. However, since home and business owners in flood prone areas can obtain structural improvement loans through the purchase of flood insurance, and because the value of the contents of these structures is expected to increase, flood damages will increase in the short run even with floodplain regulations in effect. There are other types of measures that could be implemented in the subbasin to reduce flood damages but that are not directly applicable to urban areas. These measures would include such things as land treatment programs, use of present drainage ditches for floodwater storage and use of natural areas for reversion to water retention use. Land treatment is used by some farmers in the subbasin, but the Soil Conservation Service has not been called upon to undertake a large-scale program. Present drainage ditches are not used for floodwater storage, and no plans have been developed for future use.

Information on natural areas and the various types of potentialities for increased storage is limited. Indications are, however, that wetlands play a substantial role in controlling runoff, especially in combination with good land treatment practices. Values on storage have averaged about twelve inches per surface-acre of wetlands, and have ranged to four times that amount (Cernohous, 1979). The amount of wetland habitat within the watershed area (or subbasin) is important: statistical studies indicate that in certain situations if a watershed has 15 percent of its area in wetlands or lakes, peak floods will be 60 to 65 percent lower than they would be in the absence of the wetland/lake area; if wetlands or lakes occupy 30 percent of the watershed, there will be a further reduction in flood peaks up to about 75 to 80 percent (Scientists' Report, National Symposium on Wetlands, 1978). Additional Nonstructural Alternative Study Recommendations have been included in Section XI on pages 68-69 of this report. In particular, Study Recommendation Numbers 7, 8, 11, and 13 should be totally explored to reduce flooding throughout the subbasin.

Adequacy of Existing Measures

The SCS watershed projects in the Tewaukon and Wild Rice Creek Watersheds are providing excellent flood prevention and protection. They have substantially reduced flood damages in 23 percent of the area of the Wild Rice Subbasin. These projects also have reduced the extent of flooding in the remainder of the subbasin. The present public and legal drains are functioning satisfactorily and provide some relief to localized areas for minor floods. Although existing structural measures provide some relief from flooding, they are not extensive enough nor adequate for major floods. With the exception of the aforementioned watersheds, recurring flooding is still a problem in this subbasin. Additional flood control measures are needed to further reduce the flood damages. It is recommended that nonstructural alternatives be thoroughly explored and implemented prior to the implementation of structural alternatives.

VII. CRITERIA AND PLANNING OBJECTIVES

VII. CRITERIA AND PLANNING OBJECTIVES

Floodplain Management Criteria

Technical, economic, and environmental criteria must be considered when formulating and evaluating alternative floodplain management measures for the subbasin.

The technical criteria used in formulating and evaluating alternatives for this report consisted of the application of appropriate engineering standards, regulations, and guidelines.

Economic criteria entailed the identification and comparison of benefits and costs of each measure. Tangible economic benefits must exceed costs; however, in certain instances, considerations of appropriate gains in the other accounts (environmental quality, social well-being and regional development) could alter this requirement. All alternatives considered are scaled to a design which optimizes benefits. Annual costs and benefits are based on an interest rate of 7 1/8 percent and price levels and conditions existing in October, 1979. A 50-year amortization schedule is used for the features considered.

Environmental considerations call for the formulation of measures that minimize objectionable or adverse environmental effects and maximize environmental benefits. Also, limited consideration was given to modifications based on coordination with state and Federal agencies, local interests, and citizen groups.

Planning Objectives

The primary planning objective of this study was to contribute to flood reduction needs in the subbasin and thereby provide protection from or reduction of flood losses. In conjunction with this economic objective, the study attempted to develop contributions to the environmental quality of the subbasin.

The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information that was available. On the basis of this analysis of the problems, needs, and desires that could be identified, the following planning objectives were established:

1. Contribute to protection from and prevention, reduction, or compensation of flood losses for the flood prone areas of the subbasin during the period of analysis.

2. Contribute, to the maximum extent possible, to the preservation of the quality of the existing riverine environment and enhance the environmental potential of the subbasin as a whole.

3. Contribute to the enhancement of recreational opportunities throughout the subbasin with an emphasis on the northeastern portion.

4. Contribute to the improvement of water quality in the Wild Rice River.

5. Contribute to the improvement of water supply in the subbasin primarily in the area of water quality.

6. Contribute to the reduction of wind and water erosion throughout the subbasin.

7. Contribute to the developing trend toward increased irrigation throughout the subbasin.

8. Contribute to the reduction of wastewater management problems, particularly insofar as they relate to water quality.

9. Contribute to the development of small hydroelectric installations on the Wild Rice River.

VIII. FORMULATION OF ALTERNATIVE MEASURES

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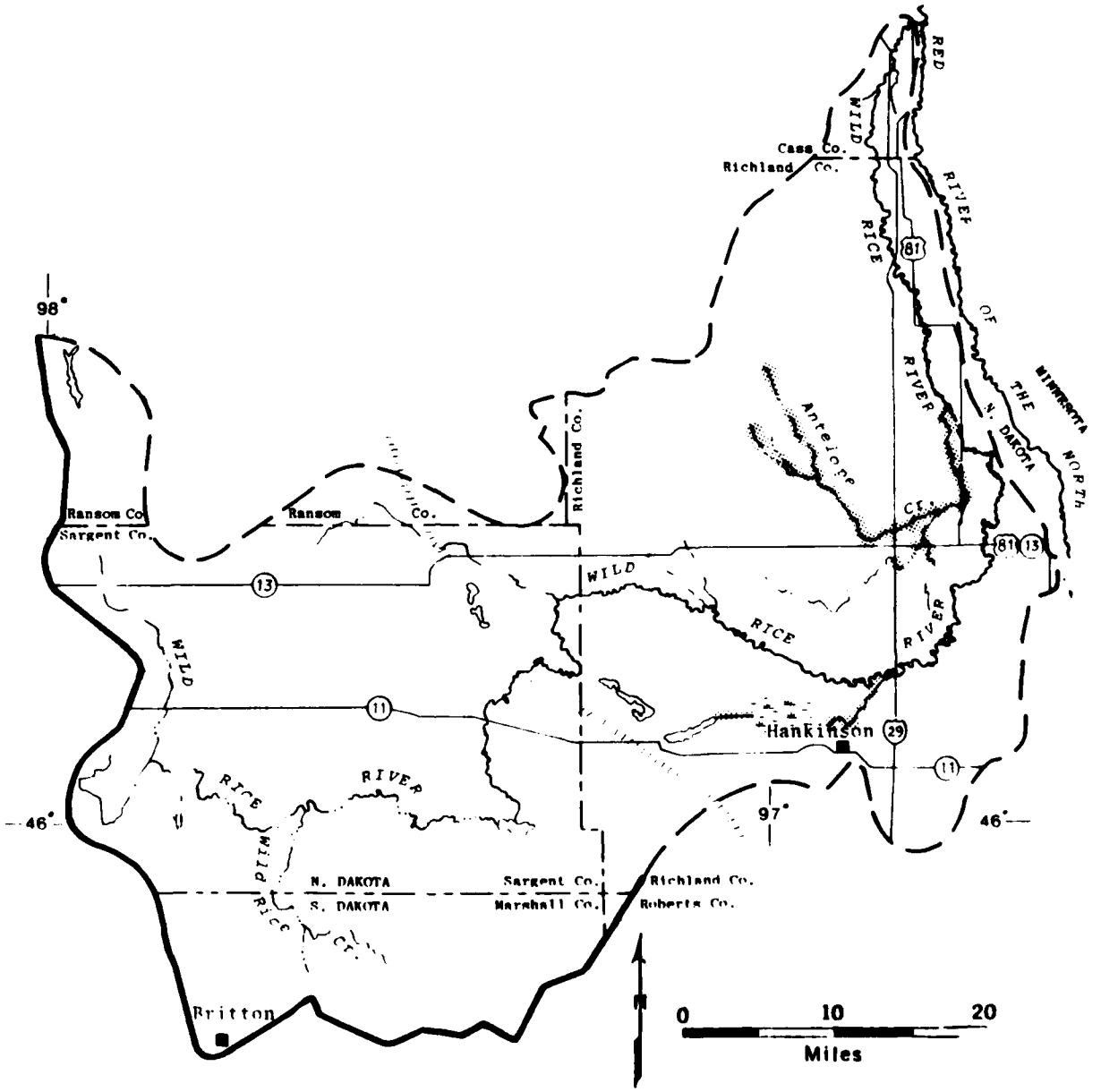
Alternative measures that have been identified to satisfy the resource planning objectives are discussed in this section. In the formulation of measures, prime consideration was given to the resolution of flooding problems. Measures to satisfy the other planning objectives were considered exclusively as components of the flood control measures.

The following measures, which are identified in Figure VI, were devised in response to the flood control planning objective:

1. Improve and enlarge 44 miles of the channels of Antelope Creek and its tributaries to contain the 10 percent (10-year) flood. This measure would provide 10 percent flood protection for the 318 square mile Antelope Creek Watershed and would protect 43,000 acres in the 10 percent floodplain. Average annual area flooded would be reduced by about 7,000 acres, which includes 5,930 acres of cropland. The implementing agency would be the Corps of Engineers.
2. Improve 11.2 miles of channel in the Wild Rice "B" watershed to contain the 10 percent flood. This measure would provide 10 percent flood protection for this 227 square mile watershed and would reduce the average annual area flooded from 4,800 acres to 950 acres, a reduction of 80 percent. The implementing agency would be either the SCS or the Corps of Engineers.
3. Construction of farmstead levees around individual farmsteads in the one percent floodplain. These levees would protect individual farmsteads against the one percent flood and could be constructed by the SCS, Corps of Engineers or private interests.

Engineering Methodology

Information used in the analysis of the channel improvement measure was extrapolated from prior studies and reports. Capital costs from these studies and reports were updated to October, 1979 price levels using appropriate "Engineering News-Record" cost indexes. Other structural measures, such as levees, upstream reservoirs, and channel enlargement in other reaches, have been extensively analyzed in prior studies and were found to lack cost feasibility. The farmstead levee measure is based on data obtained from studies by the Corps of Engineers. Capital costs for this measure reflect October, 1979 unit construction cost levels and assume that individual owners would construct their own levees.



Source: Gulf South Research Institute.

Figure VI. ALTERNATIVE FLOOD CONTROL MEASURES

Nonstructural Measures

Among the nonstructural measures considered in similar subbasins were flood warning and forecasting services, emergency protection, permanent floodplain evacuation and flood proofing. These measures are discussed in the following paragraphs.

Floodplain regulation and flood insurance are currently required by Federal policies and encouraged by the State of North Dakota. These measures primarily consist of regulating new developments in existing floodplain areas and the insuring of affected property owners for loses from flood damages. Controlling land use enables towns to meet the criteria necessary for persons living in these floodplains to be eligible to participate in the flood insurance program. Floodplain regulation should be a part of any flood protection system and could be effective in these communities and rural areas. As a supplement to floodplain regulation, flood insurance can provide limited protection to existing developments. In the long-run, floodplain regulation would theoretically eliminate all nonconforming floodplain structures, thereby reducing flood damages.

Unsubsidized crop insurance is available through the U.S. Department of Agriculture Federal Crop Insurance Program, which covers all natural disasters including floods. However, actual crop damages could be reduced only to the extent that intensive farming practices would be discouraged in the longrun in the floodplain. Because of the highly productive nature of floodplain farming, it is very doubtful that any long-term shifts away from the intensive farming of floodplain areas would occur.

Flood warning and forecasting services in conjunction with emergency protection measures have been used with reasonable success. Evacuation is possible due to the prolonged nature of the rise of flood waters from major flood events; but particularly in the case of summer floods, time would not permit the erection of emergency flood protection works. Due to the broad extent of the floodplain, the large number of persons involved, and the unavailability of facilities in neighboring communities to accommodate affected persons, this alternative is not seen as economically or socially acceptable as an effective means of solving flooding problems in the subbasin. However, it is recommended that flood warning and forecasting services be continued in order to alert floodplain residents of impending dangers.

Permanent evacuation of flood prone areas would consist of the acquisition of lands, relocation of improvements, and resettlement of the population, ultimately resulting in the conversion of land use to a state less susceptible to flood damages. Impacts of this alternative would primarily be cultural and economic in nature. Flood proofing would involve structural changes and adjustments to properties in an effort to reduce or eliminate flood damages. This is most effective when applied to new construction, but can be applied to existing structures in some instances. Permanent evacuation would result in the disruption of long-established social and cultural relationships, but could eliminate flood damages to structural units, providing that floodplain regulations were enforced. Furthermore, health and safety of floodplain residents would be enhanced, and natural habitats would be improved. However, the residual damages to agriculture and the economic, social and cultural impacts of these two measures would more than offset the benefits.

The preceeding discussion summarizes the results of prior Corps of Engineer investigations. In addition to the nonstructural measures mentioned in the Corps reports, there is an opportunity for the use of land treatment measures throughout the subbasin that would help to contain water on land as well as reduce runoff-related erosion damages. Other measures would include, but not be limited to, water retention in existing ditches and preservation of natural retention areas. These would need to be identified and retention capabilities would need to be determined. Wetland restoration could also be considered, where appropriate, for water retention.

IX. ASSESSMENT OF ALTERNATIVES

IX. ASSESSMENT OF ALTERNATIVES

Economic Assessment

Two types of flooding frequently occur in the subbasin. Channel overflow flooding affects cropland adjacent to the channels of the Wild Rice River, Antelope Creek and the Veblen Watershed south of Lake Tewaukon. Overland flooding is the other type of flooding in the subbasin, and it is often indistinguishable from channel overflow near streams. Overland flooding occurs in the Antelope Creek area and other tributary watersheds further upstream.

Alternative 1 involved channel improvements to 44 miles of the channels of Antelope Creek and its tributaries to contain the 10 percent (10-year) frequency flood. Total average annual benefits were calculated using figures reported in the Phase 1 General Design Memorandum for Flood Control and Related Purposes, Sheyenne River, North Dakota, which was completed by the St. Paul District Corps of Engineers in 1980. Since the Sheyenne River Subbasin borders the Wild Rice River Subbasin, it was assumed that a weighted average of the weighted damage per acre would be representative of conditions in the Wild Rice River Subbasin. Average annual benefits were divided by average annual costs, yielding a benefit/cost ratio of 0.95.

Alternative 2 involved improvements to 11.2 miles of channel in the Wild Rice "B" watershed to contain the 10 percent flood. Average annual benefits were updated from a prior Soil Conservation Service (SCS) report. The benefit/cost ratio for this alternative was 0.51.

Alternative 3 involved the construction of farmstead levees around individual farmsteads. This alternative would provide one percent flood protection for individual farmsteads and yielded a benefit/cost ratio of 2.10.

The effects of flood control alternatives for the subbasin with their costs and benefits are presented in Table 14.

Impact Assessment

Table 15 provides a general assessment of anticipated effects on the key resource elements of the study area resulting from each of the

Table 14

ECONOMIC EVALUATION OF ALTERNATIVES

Alternatives	Acres Protected	Average Annual Acres	Capital Costs	Average Annual Costs	Average Annual Rural Benefits	Average Annual Urban Benefits	Total Average Annual Benefits	B/C Ratio
1. Channel Improvements Antelope Creek (10% flood)	43,000	7,000*	$7,218,000	$531,300	$505,800	--	$505,800	0.95
2. Channel Improvements Wild Rice "B" (10% flood)	--	3,850	657,000	48,400	24,500	--	24,500	0.51
3. Farmstead Levees (Per levee)	--	--	$ 5,600	$ 400	$ 840	--	$ 840	2.10

*5,430 acres of cropland.

Source: Gulf South Research Institute.

Table 15

ASSESSMENT OF MEASURES, BY RESOURCE ELEMENT,
WILD RICE RIVER SUBBASIN

Measures	Social	Economics	Land Use	Biology	Water Quality	Water Supply	Cultural	Recreation
1. Channel Improvements-Antelope Creek	MoB	MoB	NkE	MaA	MiA	NkE	NkE	MiA
2. Channel Improvements-Wild Rice "B"	MoB	MoB	NkE	MaA	MiA	NkE	NkE	MoA
3. Farmstead Levees	MiB	MiB	NkE	NkE	NkE	NkE	NkE	NkE

Note: NkE = No Known Effect
MiA = Minimally Adverse
MoA = Moderately Adverse
MaA = Maximally Adverse
MiB = Minimally Beneficial
MoB = Moderately Beneficial
MaB = Maximally Beneficial

Source: Gulf South Research Institute.

three alternative measures being considered. The rationale developed for the ratings assigned each measure is presented below.

Channel Improvements-Antelope Creek and Wild Rice "B" Watershed

Channel improvements would yield moderately beneficial social and economic effects, some maximally adverse biological effects, and short-term adverse but long-term limited beneficial results for water quality elements. It is not known what effects would take place with respect to land use, water supply and cultural elements, while minimally positive recreation benefits would result from such actions.

Social and economic benefits would accrue from the flood protection and flooding reductions that would stem from the project. Some 3,900 to 43,000 acres in the subbasin would be afforded such protection, depending on the alternative selected. Possible detrimental recreation effects would result from the Wild Rice "B" alternative, since drainage of wildlife management areas would adversely affect hunting. Biological and water quality elements would be affected negatively by dredging activities, draining of wetlands, placement of dredged material, vegetation removal, and temporary turbidity.

Farmstead Levees

Localized minimally beneficial economic and social effects would result from the protection of farmsteads from frequent floods by development of ring levees. Other resource elements would not be notably affected, although aesthetic, sanitary, and maintenance factors would need to be considered.

X. EVALUATION

X. EVALUATION

Only the farmstead levees have benefits that exceed unity. These measures are also the only ones that maximize economic benefits for the subbasin, but they afford only extremely localized protection. The channel improvement measures considered for Antelope Creek had a benefit to cost ratio of 0.95, the highest following the farmstead levees.

Environmental enhancement would not result from any of the structural alternatives being considered.

National Economic Development (NED) and Environmental Quality (EQ) plans will be tentatively formulated in association with the Red River of the North basin reconnaissance report.

XI. ADDITIONAL STUDY NEEDS

XI. ADDITIONAL STUDY NEEDS

This report was developed almost entirely on the basis of secondary information from readily available planning documents. Data available from state and Federal agencies were not fully canvassed, and only a limited number of calls were made to the area. In particular, state university libraries and department resources could not be fully utilized. Thus, the document aims only at a broad-brush perspective. In order to provide a more detailed and in-depth analysis of subbasin resources, problems, and potential solutions, the following additional study needs would have to be fulfilled:

1. A literature search should be conducted to obtain available biological data for the subbasin. Fieldwork should be planned to fill in any data gaps which exist with the end result of obtaining good baseline data for the subbasin. This includes those areas where new flood control measures have been proposed, as well as updating any data for those projects which have been previously studied.
2. Areas of high environmental quality (e.g., prairie remnants and riparian woodlands) should be identified and inventoried within the subbasin.
3. Updated knowledge of the location, areal extent, and types of wetlands occurring within the specific subbasin boundaries would be extremely useful in determining whether wetland restoration would assist in alleviating flooding problems, as has been indicated by Cernohous (1979), and would provide a comparison for documenting wetland losses since the 1964 inventory.
4. Primary water and sediment quality data need to be obtained or updated to characterize baseline conditions in the streams of the subbasin, particularly in those areas where flood control measures have been proposed.
5. Information pertaining to wastewater management needs to be updated.
6. The information obtained in items 1-5 above would provide an important data base upon which an impact evaluation of proposed flood control measures can be performed and would provide information relative to the cumulative effects of flood control projects on environmental resources in the subbasin. These projects include those that are in-place or proposed.

7. Nonstructural flood damage reduction measures should be thoroughly explored, such as those listed below.

   - Establishment of buffer areas and curtailment of inappropriate residential, commercial, and other development in floodplains.
   - Maintenance and enhancement of existing riparian vegetation along the Wild Rice River and tributaries to conserve and restore wildlife habitats, help control wind and streambank erosion, retain soil on the land, and to reduce the amount of sediment, nutrients, and other pollutants entering waterways.
   - Maintenance of grassed waterways to reduce erosion.
   - Establishment of vegetation in areas of critical erosion.
   - Determination of the feasibility of installing water control structures at existing culverts to retain water in drainage ditches for longer periods of time during critical runoff periods to minimize flooding in downstream areas.
   - Determination of the feasibility of utilizing "on-farm storage" to control runoff through such means as natural storage areas and control structures on existing culverts.
   - Prevention of overgrazing on grasslands and utilization of sound agricultural land use practices.
   - Provision for strict enforcement of floodplain management programs within the subbasin.

8. The potentiality for land treatment measures (e.g., erosion control measures such as cover crops, green belts, reduction in fall tillage, etc.) needs to be thoroughly investigated.

9. The people of the subbasin need to be included in further water resource planning efforts. A public involvement program would provide more complete information on water resource problems and opportunities than is presently available.

10. More study is needed to determine the precise nature of the water supply problems and potential solutions.

11. Potentialities for floodwater storage in present drainage ditches need to be investigated.

12. The effect of drainage works on flood discharges and stages is unknown at present. It would take additional, more detailed studies to determine the extent and effect of reduced natural storage.

13. Land use within the floodplain needs to be precisely identified.

14. An adequate 100-year floodplain map needs to be developed. Also, the extent of floodplains for smaller frequency storms needs to be delineated.

15. More gauging stations need to be developed to provide hydrologic data for establishing flood frequencies and rating curves.

16. Channel cross-sections of the various streams need to be prepared for flood control planning purposes.

17. Crop distribution in the floodplain needs to be precisely identified through contact with county agents, and average annual rural damages need to be updated.

18. The irrigation potentials of the subbasin soils need to be investigated.

19. A comprehensive and up-dated inventory of recreation sites would be required to accurately identify resources.

20. Studies are needed to determine additional demand for recreational facilities, usage of existing facilities, and potential sites.

21. A regional supply and demand analysis for hunting, fishing, and other water based or related recreational pursuits is needed.

22. Whether forested acreages in the floodplain are increasing or declining needs to be precisely determined.

23. A detailed institutional analysis of the subbasin is needed. As part of this study, the objectives, goals, and programs of the many institutional entities involved in water resources planning, particularly at the local level, is needed to determine the most efficient institutional approach to the resolution of flooding problems.

24. A detailed social profile of the subbasin is needed.

25. Urban damages need to be recomputed in a systematic fashion.

26. A review of secondary sources and systematic field reconnaissance is needed to identify archaeological and historical sites and to determine their eligibility for nomination to the National Register of Historic Places.

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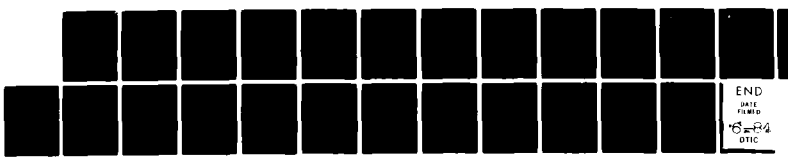
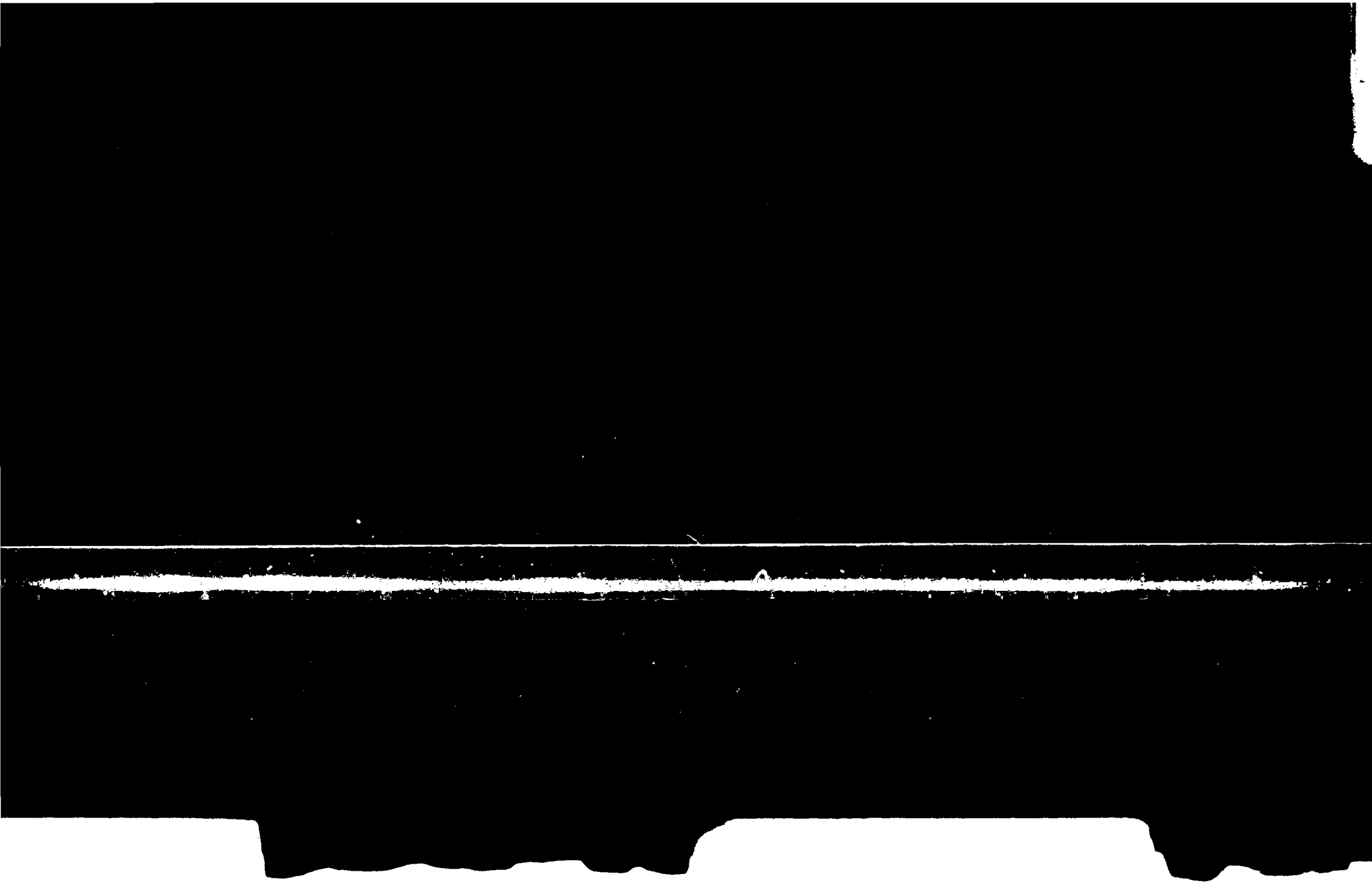
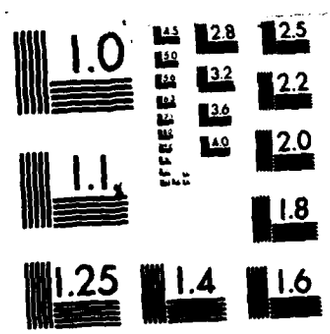






Appendix A
FLOODPLAIN DELINEATION

Appendix A
FLOODPLAIN DELINEATION

Prior to this study, no attempt was made to publish a generalized delineation of the entire Wild Rice River floodplain. In undertaking this task, the present study utilized all known sources to provide the best available data for generalized delineation of the U.S. portion of the subbasin at a scale of 1:250,000. Principal sources were: USGS Flood Prone Area Maps (scale 1:24,000), Federal Insurance Administration flood maps for available incorporated areas, published secondary sources, U.S. Geological Survey (USGS) 7 1/2 minute Topographic maps, and other sources, including derived data where necessary.

The Flood Prone Area Maps published by the USGS provided detailed and highly accurate information on the area mapped. Five full sheets and parts of five others provided most of the detail for the floodplain delineated in Figure II. With the exception of Lake Tawaukon, all of the coverage associated with the Wild Rice River is found in the eastern half of the subbasin. Four USGS topographic quadrangles provided limited information for inference regarding the central portion of the subbasin.

Unlike the extensive coverage of the Minnesota side provided by Federal Insurance Administration flood maps, only selected incorporated areas are generally available in North Dakota. Ransom County, North Dakota, and Marshall County, South Dakota, joined the emerging program in 1978, but only the unincorporated area of the latter has been mapped. The portion of Cass County within the subbasin has also been mapped. Richland and Sargent Counties, North Dakota, and Roberts County, South Dakota, are not listed as members of the flood insurance program. Six community maps of incorporated areas also provided limited information.

Secondary sources, such as the Souris-Red-Rainy River Basins Type II Study were also utilized. Published floodplain descriptions and acreage estimates in the Red River of the North Survey Report of 1947 and the 1963 Flood Control Reconnaissance Report on Antelope Creek were compared to the delineated floodplain in this report. The former indicated that most frequent flooding occurred in the vicinity of Great Bend, located

at mile 102. From mile 77 to mile 108, 6 miles is cited as the maximum floodplain width, decreasing to between 1,000 and 2,000 feet above mile 108. The estimated area encompassed is cited at 53,000 acres. However, because of the date of publication, it is not known how well the figure reflects current conditions, which are estimated at 52,000 acres in Figure II.

The second publication cites 42,000 acres as flooded in the vicinity of Antelope Creek in May of 1962. Not only is this figure roughly comparable to that shown for the entire subbasin, but also the study cites that preliminary discharge frequency studies indicate that a flood of this magnitude occurs about once in six years and that an average of about 7,000 acres floods annually in the Antelope Creek area. The 100-year floodplain delineated in this study is only 2,000 acres in extent, indicating a wide discrepancy of data.

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) WILD RICE SUBBASIN

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) WILD RICE SUBBASIN

Number	Name	Administration	Location	Acres	Campgrounds[2]	Playground	Athletic Field[3]	Golf Courses[4]	Boat Ramps	Picnic Tables	Beach	Pool	Trails[5]
1	Englevale Slough WMA	State	Ransom Co. 13458W10 Englevale	160.0									
2	Storm Lake NWR	Federal	Sargent Co. 13054W12 Cayuga	779.0									
3	Mooreton Pond WMA	State	Richland Co. 13249W09 Mooreton	56.0									
4	Crete Slough WMA	State	Sargent Co. 13258W36 Gwinner	151.0									
5	Wild Rice NWR	Federal	Sargent Co. 13054W12 Cayuga	779.0									
6	Krause Slough	Federal	Sargent Co. 13053W04 Cayuga	161.0									
7	Wild Rice WMA	State	Richland Co. 13152W28	2,089.0									
8	Swan Lake WMA	State	Richland Co. 13051W07	289.0									
9	Slack Slough WMA	State	Richland Co. 13050W07	597.0									
10	Lake Elsie NWR	Federal	Richland Co. Hankinson	634.0									
11	Mud Lake WMA	State	Richland Co. 13050W22 Mud Lake	351.0									

-continued-

Appendix B (Cont'd)

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) WILD RICE SUBBASIN

Number	Name	Administration	Location	Acres	Campgrounds[2]	Playground	Athletic Field[3]	Golf Courses[4]	Boat Ramps	Picnic Tables	Beach	Pool	Trails[5]
12	Sheyenne National Grasslands	Federal	Richland County 13352W04 Hankinson	42,222.0									
13	Grant Township WMA	State	Richland Co. 13052W20 Lidgerwood	160.0									
14	Park Lake WMA	State	Richland Co. 12952W06 Park Lake	160.0									
15	Meszaros Slough WMA	State	Sargent Co. 13057W17 Forman	598.0									
16	Lake Tewaukon NWR	Federal	Sargent Co. 13055W35 Rutland	6,864.0									
17	Tewaukon WMA	State	Sargent Co. 13053W00 Rutland	1,284.0									
18	Douglas Game Production Area	County	Marshall Co. 7 miles NW and 1½ miles N of Lake City	359.0									
1	Forman Park	Municipal	Sargent Co. Forman	74.0	X		4	9		8			
2	Lidgerwood Park	Municipal	Richland Co. Lidgerwood	60.0		2	3			14		1	

-continued-

Appendix B (Cont'd)

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) WILD RICE SUBBASIN

Number	Name	Administration	Location	Acres	Campgrounds[2]	Playground	Athletic Field[3]	Golf Courses[4]	Boat Ramps	Picnic Tables	Beach	Pool	Trails[5]
3	Hankinson Park	Municipal	Richland Co. Hankinson	25.0	40	2	5		20				
4	Silver Lake Recreation Area	County	Sargent Co. 13055W33 Rutland	210.0	X	1			1	30	1		
5	Frenier Dam	County	Sargent Co. 12954W08 Sisseton and Wahpeton Indian Reservation	40.0									
6	Havana Park	Municipal	Sargent Co. Havana	18.0	10	1	1			5			
1	Gwinner Golf Course	Municipal	Sargent Co. Gwinner	120.0				9					
2	Sargent County Fairgrounds	County	Sargent Co. Forman	40.0			1						
3	Lidgerwood Golf Course	Municipal	Richland Co. Lidgerwood	40.0				9					
4	Hankinson Golf Course	Private	Richland Hankinson	30.0				9					
5	Hankinson Snowmobile Club	Private	Richland Hankinson	50.0									10

[1] Facilities included are those with 15 or more acres.

[2] Number of campsites.

[3] Number of fields.

[4] Number of holes.

[5] Number of miles.

Source: North Dakota State Parks and Recreation Department, Inventory of North Dakota Outdoor Recreation Facilities, 1979.

Gulf South Research Institute.

Appendix C
COMMENTS

Appendix C

COMMENTS

The purpose of this subbasin report was to provide an overview of the water and related resource problems and needs and to assess potential solutions. Toward this end, draft copies of this report were circulated to Federal, State, and local agencies and comments were sought.

This review resulted in complete and factual documentation. Thus, the study should serve as a building block for the timely completion of future water resource efforts within the subbasin. Further cooperative efforts are, however, needed to evaluate these tentative results and to develop potential solutions.

A distribution list and copies of the comments made with respect to the draft report are included as part of this appendix. Comments that resulted in specific modifications to the draft text are marked by an asterisk.

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

NCSED-PB

20 November 1980

Mr. Mike Liffmann
Project Manager
Gulf South Research Institute
8000 GSRI Avenue
Baton Rouge, Louisiana 70808

Dear Mr. Liffmann:

The draft Wild Rice River subbasin, North Dakota, report was distributed for review and comment. Interagency comments will be provided when they are received.

a. Inclosure 1 is the general office comments that need to be considered when preparing the final Wild Rice River subbasin report and the remaining subbasin reports.

b. Inclosure 2 identifies specific office concerns that are applicable to the Wild Rice River subbasin.

If you have any questions on our comments or proposed modifications, please contact us.

Sincerely,

Louis Kowalski

LOUIS KOWALSKI
Chief, Planning Branch
Engineering Division

2 Incl
As stated

United States Department of the Interior
FISH AND WILDLIFE SERVICE
AREA OFFICE—NORTH DAKOTA
1500 CAPITOL AVENUE
P.O. BOX 1897
BISMARCK, NORTH DAKOTA 58501

NOV 1 8 1980

Colonel William W. Badger, District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Re: Red River Mainstem (CE)

Dear Colonel Badger:

This letter provides U.S. Fish and Wildlife Service (FWS) comments on the Draft Reconnaissance Report recently compiled by the Gulf South Research Institute for the Wild Rice River Subbasin in Ransom, Sargent, Richland and Cass Counties, North Dakota.

As expressed in our comments on previous subbasin reports, our major concerns are associated with the woodland, grassland, wetland, riverine and riparian flood-plain habitats that still remain within this subbasin. Much of the woodland, grassland and wetland habitat in the eastern half of the subbasin has been converted to agricultural uses. We agree with the statements on pages 11, 25, 37 and 39 that these remaining grassland, woodland and wetland habitat types are significant and need to be protected, conserved and enhanced within the subbasin.

The report addressed three structural alternative measures that have been identified to date to meet the study's flood damage reduction objective. The report indicated, however, that only one of these measures has a favorable B/C ratio and appears to be economically feasible. These measures and our comments relative to each are as follows:

Alternative 1 - Channel Improvement and Enlargement

This alternative consists of improving and enlarging 44 miles of the channels of Antelope Creek and its tributaries to contain the 10 percent (10 year) flood. This measure would provide 10 percent flood protection for the 318 square mile Antelope Creek Watershed and would protect 43,000 acres in the 10 percent flood plain.

In our view, channelization projects constitute short-term, piecemeal and localized attempts to reduce flooding problems that disregard effective long-range solutions and place an added burden of flood waters on people and property downstream. It is the FWS's belief that wetland drainage, both legal and illegal, is one of the principal causes for the increased frequency of flooding in the Red River Basin to date. In the past, stream modification alternatives in the Prairie Pothole Region of eastern North Dakota and western Minnesota facilitated the drainage of existing wetlands, in addition to those already drained in the project area. This alternative did not have benefits that exceed costs. If this alternative is implemented, adverse environmental impacts will be severe.

Alternative 2 - Channel Improvements

This alternative consists of 11.2 miles of channel improvements in the Wild Rice "B" Watershed to contain the 10 percent flood. This measure would provide 10 percent flood protection for this 227 square mile watershed and would reduce the average annual area flooded from 4,800 to 950 acres, a reduction of 80 percent. This alternative does not have benefits that exceeds costs. If this alternative is implemented, adverse environmental impacts will be severe.

Alternative 3 - Farmstead Levees - We do not anticipate any adverse environmental impacts due to this alternative provided the dikes are not constructed through wetland areas and impacts to existing woodland vegetation are avoided to the extent possible.

Generally, we find the draft report to be a well written review of the water and related land resources, problems and possible solutions to some of these problems within this subbasin of the Red River of the North. We suggest, however, that the following changes be made in the report:

1. Page 26, second paragraph, fourth sentence - We suggest this sentence be changed to read as follows: "Typical furbearers are the red fox, skunk, raccoon, beaver, muskrat and mink".

2. Page 28, second paragraph, third sentence - We suggest this sentence be changed to read, "These lakes (Silver, Sprague and Tewaukon) provide a high valued sport fishery for bluegill, walleye, crappie, yellow perch and northern pike".

3. Page 28, second paragraph, sixth sentence - We suggest this sentence be changed to read as follows: "The Wild Rice River from Lake Tewaukon to its mouth at the Red River of the North has been designated by the ND Game and Fish Department (1978) as a high priority (Class II) stream that provides moderate sport and forage fish production".

4. Page 33, first paragraph, under the heading "Recreation Resources" - We suggest this paragraph be changed to read as follows:

> "Water related recreation resources are fairly abundant, and hunting and fishing resources are excellent in the central and western portions of the subbasin. There are approximately 16,161 acres of recreational lands in the subbasin. One National Wildlife Refuge is owned in fee title for a total of approximately 6,864 acres. In addition, there are approximately 2,192 acres of privately-owned easement refuges. The easements provide for the impounding of water and restriction of hunting only. State Wildlife Management Areas total approximately 5,895 acres. The distribution of the subbasin's recreational areas, as illustrated in Figure III, basically conforms to the topographical pattern of the area. Most of the sites are located in the morainic hills of the southwestern portion of the subbasin. An inventory of facilities for areas larger than 15 acres, which comprise 99 percent of the total recreational acreage, is presented in Appendix B of this report."

5. Page 35, first sentence - We suggest this sentence be ch as follows: "Hunting opportunities are abundant in the illustrated by one National Wildlife Refuge and 13 State Management Areas".

6. Page 35, second paragraph, second sentence - We suggest be changed to read, "The lakes, particularly Silver, Spr Tewaukon, are noted for walleye, crappie, perch and nort

7. Page 35, second paragraph, last sentence - We suggest th changed to read, "The fishery value of the Wild Rice Riv from Lake Tewaukon, gradually increases as the river appr confluence of the Red River of the North".

8. Page 39, first paragraph, under the heading "Waterfowl P We suggest this paragraph be changed to read as follows:

> "Waterfowl Production Areas (WPA's) are wetland areas U.S. Fish and Wildlife Service (FWS) has either acquir fee title, or obtained an easement interest in, to pre valuable breeding, nesting and feeding habitat for mig waterfowl. These wetland areas are purchased, or an e interest obtained, with funds received from the sale o bird hunting and conservation stamps (Duck Stamps). T WPA's are signficant because they provide the public w great variety of wildlife-oriented recreational oppotu as well as providing valuable habitat for migratory wa and many other forms of wildlife. FWS is responsible compatibility determinations (uses) and the issuance a of permits involving these lands. WPA's acquired in f are managed for optimum wildlife production, particula waterfowl. On easement WPA's, the rights acquired are to the burning, draining and filling of wetland basins right of access. All other property rights remain wit landowners. The approximate locations of the WPA's aq fee within the subbasin are shown in Figure IV. Total of these WPA's, fee and easement, included in the subb listed in Table 9."

9. Page 40, Figure IV - Place "fee tracts" in parenthesis af We believe at least 37 WPA's should be identified by a do IV. We have attached a copy of Figure IV indicating the locations of these WPA's (Attachment 1).

10. Page 41, first paragraph, last two sentences, under the h or Endangered Species" - We suggest these two sentences b the report. The Dakota Skipper has been, at least tempor as a proposed threatened species by the U.S. Fish and Wil

11. Page 42, first paragraph, first sentence, under the headi Plants" - Remove "(no date)" and insert "(1976)".

12. Page 54, second paragraph - We suggest the following sentences be added to this parargraph: "Additional Nonstructural Alternative Study Recommendations have been included in Section XI on pages 68-69 of this report. In particular, Study Recommendation Nos. 7, 8, 11 and 13 should be totally explored to reduce flooding throughout the Wild Rice River Subbasin".

13. Page 55, last sentence - We suggest this sentence be changed to read as follows: "Additional flood control measures are needed to further reduce the flood damages. It is recommended that nonstructural alternatives be thoroughly explored and implemented prior to the implementation of structural alternatives".

14. Page 65, second paragraph, last sentence, under the heading "Channel Improvements - Antelope Creek and Wild Rice 'B' Watershed" - We suggest this sentence be omitted from the report. It is doubtful, at best, to conclude that water quality will be appreciably improved after the channelization of 55 miles of the Antelope Creek/Wild Rice River Watersheds. In the view of the FWS, water quality will be further degraded over the short and longrun scenarios resulting from this structural alternative.

15. Page 67 - Add "riparian woodlands" to Recommendation No. 2.

16. Page 70, Bibliography Citation No. 1 should read as follows:

> Barker, William T., Gary Larson and Richard Williams. 1976. "Rare and Unique Plants of North Dakota". Department of Biology, Agricultural Experiment Station, North Dakota State University, Fargo, North Dakota.

17. Page 75, Bibliography Citation No. 5 should read as follows:

> _____. 1978. "Terrestrial and Aquatic Resources Package for North Dakota Tributaries to the Red River of the North". Area Office, Bismarck, North Dakota.

18. Page 75, Bibliography Citation No. 6 should read as follows:

> _____. 1980. "Terrestrial Resources Package for Minnesota Tributaries to the Red River of the North". Ecological Services Office, St. Paul, Minnesota.

These comments have been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and other authorities mandating Department of the Interior concern for environmental values. They are also consistent with the intent of the National Environmental Policy Act of 1969.

The opportunity to review and comment on the Draft Reconnaissance Report of the Wild Rice River Subbasin is appreciated.

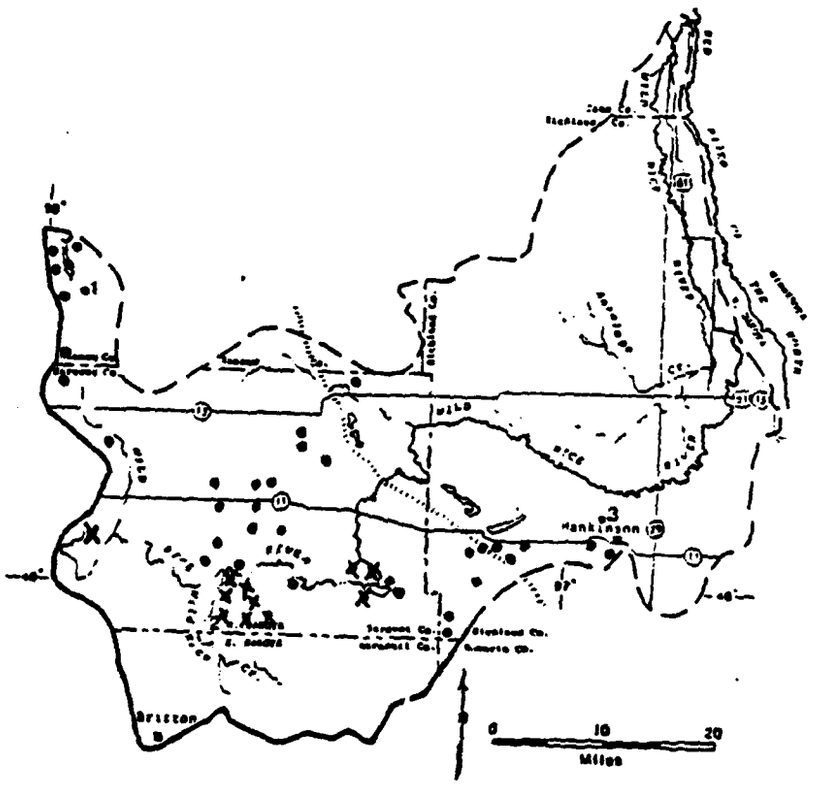
Sincerely yours,

M. S. Jennewein

for Gilbert E. Key
Area Manager

C-6

ATTACHMENT 1



● NATURAL AND SCIENTIFIC AREAS
1 Englevale Slough
2 Havana Prairie
3 Hankinson Dunes
● WATERFOWL PRODUCTION AREAS (Fee Tracts)

*Exact locations and numbers of waterfowl production areas are on file at the U.S. Fish and Wildlife Service, Area Office, Bismark, North Dakota. No copies of these maps have been published or released but can be reviewed at the above office.

Source: State Comprehensive Outdoor Recreation Plan, 1975; Kantrud, 1973; USFWS 1980.

Figure IV. WATERFOWL PRODUCTION AREAS AND NATURAL AND SCIENTIFIC AREAS

NORTH DAKOTA
STATE WATER COMMISSION
bismarck 58505
north dakota

December 10, 1980

Col. William W. Badger, District Engineer
St. Paul District Corps of Engineers
1135 U.S. Post Office & Customhouse
St. Paul, MN 55101

RE: Red River Mainstem Study - SWC Project #1701

Dear Col. Badger:

This letter is to provide comments on the draft reports for the Maple River Subbasin, Wild Rice River Subbasin, and Mainstem Subbasin for the Red River of the North Reconnaissance Study.

In the Maple River Subbasin Report, the implication is made that the only forms of valuable recreational resource are large bodies of water and forest tracks. This is not true, since even within the Maple River Basin there are areas suitable for canoeing and hiking which are considered valuable by some. Other forms of limited recreation do exist, as is mentioned in the report. The section on water quality problems should be quantified if possible. Use of such terms as "excessive", "insufficient", and "exceeds", can be very deceiving when not quantified. Quantified soil loss figures should be available from the Soil Conservation Service. These figures could be used to quantify the erosion problems. The North Dakota State Health Department should be contacted to determine whether or not improved waste water treatment facilities are planned for the communities within the subbasin.

Under the section titled "Public Perception of Problems and Solutions", mention should be made that there are county water management boards which have been organized for years. These boards could help in providing information for this section. Credit should also be given to the Soil Conservation Service in this section for their involvement in the watershed planning or P.L. 566 Program. In the "Transportation Network" section, a statement should be made as to the condition of the transporation system within the subbasin, excluding the major state and federal highways. Throughout the report, reference is made to ground wells. The word "ground" should be deleted from this phrase, since ground and well are redundant in this instance. The section entitled "Aesthetics"

should be deleted from the report. Since aesthetically appealing views are not defined in the report, they may mean different things to different people. For those people living within the subbasin, the existing landforms although featureless, may be very appealing to them.

On page 33, reference is made to the "Cernhous Report". Since this report is not thoroughly documented, nor is complete evidence available to support all of the findings of the report, reference should not be made to it. Also on that page, the section addressing the number of wetland acres remaining in the subbasin should be deleted. The method used to expand the 1964 survey may not be very scientific since the 1964 survey may have not been a random sample. Also, the section is very confusing since the information appears to pertain only to 1964 data, and it would be impossible to update this to 1980 data. In the "Waterfowl Production Area" section, the implication is given that all easement areas that are obtained through the wetland easement program are considered to be waterfowl production areas. This is not true, since generally Waterfowl Production Areas are only those areas owned in fee title by the U.S. Fish and Wildlife Service.

In the section entitled "Threatened and Endangered Species", mention should be made as to when the black-nose shiner was actually last recorded in the Maple River. Under "Other Important Species", mention should also be made as to when the three species mentioned were last verified within the subbasin. In the "Rare and Unique Plants" section, were the 12 species listed actually recorded within the Maple River Subbasin, or were they just recorded within those counties?

On page 45, mention is made of seven state agencies which are involved directly in water and related land resources planning. These seven agencies should be listed. Also on that page, in the final paragraph, mention should be made of the state agencies, such as the State Water Commission, which should be consulted in devising flood control measures for the subbasin. Again on page 48, reference is made to the "Cernhous Report". As mentioned before, this reference should not be made. Further in that paragraph, reference is made to a statistical study, not being familiar with this study, I do not believe that it could be applicable to the watersheds within North Dakota. Because of the characteristics of watersheds within North Dakota, it would be impossible to realize a 75-80% reduction in flood peaks if only 30% of the watershed was in wetlands. This would almost imply that there was virtually no runoff from the remaining 70% of the watershed.

In the chapter entitled "Formulation of Alternative Measures", a recommendation is made to construct agricultural levees along the Maple River. The basis for the spacing of these levees should be mentioned. At a minimum, the spacing should be such that the levees would comply

with criteria now in existence for the Red River, which does not allow for more than a six inch increase on the 100 year flood. In the chapter entitled "Assessment of Alternatives", the nonstructural measures should be mentioned and an estimate of the economic impact made.

In the Wild Rice River Subbasin Report, the statement is made that floods within the subbasin are almost an annual event. This statement should not be made unless it can be quantified and shown that floods do occur that frequently. The statement does imply that this frequent flooding causes damage. In some recent situations, flooding may occur but there may not be damage associated with it. In the section on "Waste Water Management", the statement is made that releases from inadequate treatment systems have severely degraded the river's water quality. The reference for this statement does not have a date; it is possible that since this reference was published that the communities within the basin have improved their waste water management systems. If this is true, that statement may not apply to existing conditions. On page 16, the statement is made that no watershed districts exist in the Wild Rice River basin. This is not true since there are water management boards within each county within the subbasin. On page 36, reference is made to a "high" table. This should be corrected to read "high ground-water" table.

The same comments which were made on the "Wetlands" section of the Maple River Subbasin Report would apply to the "Wetlands" section of the Wild Rice River Subbasin Report. The expansion of the 1964 data would not be accurate, and would not apply to today's conditions. On page 51, the State Water Commission should be listed as an agency to be consulted in future flood control planning. On page 54, reference is again made to the "Cernhous Report", which should be deleted. In that same paragraph, the same statistical studies as were referenced in the Maple River Subbasin Report are used. The same comment made regarding the Maple River Subbasin Report would apply here. In the "Assessment of Alternatives" chapter, a discussion should be made regarding nonstructural measures. The economic assessment of Alternative 1, Channel Improvements to 44 Miles of Antelope Creek, should be looked at more closely since the benefit/cost ratio comes very close to approaching unity. By using estimates from reports pertaining to other subbasins, it's very possible that there may be slight variations in the subbasins which could cause benefits to be slightly greater, thus this alternative should be carried forth to the "Evaluation" chapter.

In the Mainstem Subbasin Report, greater emphasis should be placed on the water supply problems being experienced by the City of Fargo. In 1977, Fargo had to import water from the Sheyenne River Basin to meet its water supply demands. In the"Public Perception of Problems and Solutions" section, mention should be made of the informal agreement

between the Lower Red River Watershed District and the Red River Joint Water Management Board. This informal agreement calls for cooperation between these two entities in attempting to manage the water of the Red River Basin.

On pages 49 and 51, reference is again made to the 1964 Inventory of Wetlands. For the same reasons as mentioned earlier, reference to this particular inventory should be deleted. In the comparison made between the 1964 and the 1974 inventory within the Minnesota counties, it can be seen that expanding the 1964 data by multiple of four does not yield accurate estimates for a 100% survey.

On Table 13, pages 56 and 57, a column should be added to show the most recent date of a confirmed siting of the threatened or endangered species. A similar column should be added to Table 14, for rare and unique plants.

On page 67, reference should be made to the two large water management entities which have authority within the Mainstem. These include the Lower Red River Watershed Board in Minnesota and the Red River Joint Water Management Board in North Dakota. On page 73, the statement is made that agricultural levees on the Mainstem have been instrumental in preventing agricultural losses. The quantified basis for this statement should be included. The statement should go on to say that the same agricultural levees have been instrumental in aggravating agricultural losses in unprotected areas.

On page 76, the structural measure addressing agricultural levees should state that the levees would be constructed in compliance with the existing criteria and agreement between the states of North Dakota and Minnesota. This same statement should be added to the last paragraph on page 89, and also to the first paragraph on page 91. On page 91, separate benefit/cost ratios should be listed for each of the reservoirs included in Alternative 5.

Overall, all three reports contained much valuable information. It does appear as though these reports make a greater attempt at identifying water management problems which exist throughout the basins, and are not totally restrictive to flood control problems. This is an improvement over previous reports.

Sincerely,

Cary Backstrand
for
David A. Sprynczynatyk, P.E.
Director of Engineering

DAS:sh

GENERAL COMMENTS
DRAFT WILD RICE RIVER SUBBASIN REPORT
(OCTOBER 1980)

(These comments apply to the entire report and all subsequent subbasin documents.)

1. Comments from Federal, State, and local agencies and a letter from the St. Paul District will be included in an appendix in each final subbasin and in the overall report. The format for the appendix will be:

a. Introduction - This section should stress:

(1) The importance of completing the study on time.

(2) That the purpose of the study is to advise other agencies and interests.

(3) The need for a selected review by various interests to provide complete and factual documentation.

(4) The use of the study as a building block for future water resource efforts.

(5) That cooperative efforts to evaluate results and develop solutions to remaining problems will be incorporated.

(6) A complete public involvement program when the study is finished.

b. The distribution list.

c. Copies of letters of comment.

Only comments that identify significant errors or need specific attention will be addressed in the final subbasin report. However, all comments incorporated should be identified with a marking system.

2. Care should be taken to ensure that similar data reported in the various draft reports are uniform and consistent. For example, in the climate sections temperatures are recorded in ranges, means, and averages. Also, any number presented should not be presented as more accurate than the data from which it was developed. Suggest rounding off all numbers.

3. The supporting information for alternatives including technical, economic, and environmental backup data should be provided (at least under separate cover).

4. All references by the same author and of the same year should be ranked (i.e., 1979a, 1979b, etc.) so that these references can be distinguished.

Incl 1

5. The evaluation section of each report is primarily the recommendations of the document. Generally only the alternatives which have a benefit-cost ratio greater than 1 are presented. Little attention is given to other less economically feasible alternatives that may be important in specific aspects of future flood damage reduction planning for the subbasin as well as the basin as a whole. Some of these alternatives may provide the necessary environmental or social conditions to warrant future attention. Therefore, this section should be expanded to provide the appropriate discussions.

6. The 1980 current normalized prices issued in October 1979 were revised in July 1980. Label all references to current normalized prices as "prerevision" or "postrevision" as appropriate.

7. The lack of large lakes and sizable forest tracts combined with poor water quality in existing rivers severely limits the diversity of recreation opportunities in most subbasins. Therefore, it is extremely important that alternative flood control measures be analyzed for their impacts upon those areas that do contain large lakes, sizable forest tracts, and rivers with good water quality.

ST. PAUL DISTRICT
CORPS OF ENGINEERS
SPECIFIC COMMENTS ON THE
WILD RICE RIVER, NORTH DAKOTA SUBBASIN REPORT

1. Page 5, Figure I - The escarpment, Lake Tewaukan, and the National Wildlife refuge should be identified.

2. Page 8, Figure II - See specific comment 1.

3. Page 9, paragraph 4, line 1 - Change "Gread" to "Great."

4. Page 16, Public Perception of Problems and Solutions - The reason that the public perception of problems and solutions is not adequately defined is not because the Corps has not conducted recent public meetings in the area: it is doubtful that a few public meetings would enable these factors to be adequately defined. The social analysis which would yield this information is identified on page 69 of this report as an area needing further study. This section should be rewritten to reflect other limitations besides the lack of recent public meetings.

5. Page 17, Social Characteristics - Ransom County's in-migration should also be identified as net in-migration if, in fact, net migration was noted. If not, what was the net migration?

6. Page 18, Social Characteristics - There is no Lake Traverse Reservation. This should be identified as the Sisseton Reservation.

7. Page 18, Social Characteristics - The 3,602 Indians are not too small a minority population to be identified. This figure represents approximately 20 percent of the identified total population of the subbasin. In addition, sugarbeet farmers bring a large number of Mexican migrant workers into the subbasin each summer. These Mexican-Americans should also be counted as minority members, unless only permanent residents are being counted.

8. Page 18, Social Characteristics - The term "close-knit" seems inappropriate given the indicated items on which it is based. This term implies social integration which may or may not be based on home ownership and length of county residence and employment. A different term should be used.

9. Page 19, Income - The distribution of income (such as percentage of population below the poverty level, etc.) should be included.

10. Page 19, Agriculture - In addition to the factors noted on yield per acre, harvested acres, and total production for particular crops, it would be helpful if gross income per acre for particular crops were included. This information would give a better understanding of the relative importance of each crop. One other factor that would aid understanding of flooding problems is the differential in susceptibilities of crops to flood damages. Some crops are not as seriously affected by a flood event as others. In addition, the differential in costs per acre to plant particular crops would aid understanding.

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11. Pages 19 and 20, Income and Trade - What is the correction factor used to convert figures to 1979 dollars? It would be helpful if it were included.

12. Page 22, Land Use Section - The remaining 1.1 percent of land use should be identified.

13. Page 25 - The discussion of white-tailed deer populations should indicate that population densities of >71.7 deer/square mile are considered high only for North Dakota.

14. Page 32, paragraph 2 - Change the 5th sentence to read, "...Wild Rice River, although three archeological...".

15. Page 33, paragraph 1 - Change "tribesman" to "people" in fourth sentence.

16. Page 33, paragraph 2 - The last sentence should read, "There are currently two historical sites listed on the National Register of Historic Places in the subbasin. Additional surveys will probably identify other significant prehistoric and historic resources in the subbasin."

17. Page 35, Social - In addition to the information presented, a discussion of the social consequences or implications of flood events should be presented, particularly those concerning behavioral damages that may occur should further study in this subbasin be warranted.

18. Page 36, paragraph 2 - Change "archaeological" to "cultural" in first sentence.

19. Page 37, paragraph 3, line 6 - It should be indicated why the Type I wetlands were not measured in the 1964 survey. There may be a definite reason for this. If so, the 10-15 percent of Type I land out of the total wetland acres in the Prairie Pothole Region may not represent a reasonable number of acres. The numbers used in this paragraph and in the corresponding table on page 38 have to be rounded off to more accurately reflect the estimated number.

20. Page 40 - The location of the Sheyenne National Grasslands should be identified on the map. Also see comment 1.

21. Page 41, Threatened or Endangered Species - The U.S. Fish and Wildlife Service did not make a final determination on the status of the Dakota Skipper within two years of its proposed listing. Consequently the Dakota Skipper has been withdrawn from consideration as an endangered species.

22. Page 54, paragraph 2, line 4 - "Value" is misspelled.

23. Page 54, paragraph 2, last sentence - The location of the statistical studies should be identified. If not in the Red River basin, it is doubtful that the information is transferrable. Therefore, suggest deletion of this sentence.

24. Page 56, Planning Objectives - The second paragraph is too strongly stated. Rewrite as follows:

> "The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information that was available. On the basis of this analysis of the problems, needs, and desires that could be identified, the following planning objectives were established."

25. Page 58 - Although the Wild Rice "B" watershed is mentioned several times in the report, (pages 12 and 53) the location of this watershed is not readily apparent. It appears from Figure VI, that the proposed alternative would involve channel improvements in the vicinity of Hankinson to the Wild Rice River. It is reported that this alternative would reduce the area flooded from 4,800 acres to 950 acres. However, this area does not appear to be included in the description of the 100-year floodplain on pages 8 and 9, nor is the channel area near Hankinson in Figure VI shown on the other maps. These inconsistencies have to be corrected.

26. Page 62, Assessment of Alternatives Section - Care should be taken in the assessment section when referencing borrow pits and channelization impacts on existing and future potential recreation opportunities. Channel modifications and/or diversions not only alter the natural appearance of waterways, they also destroy, in many instances, the existing vegetation and fish habitat that attract recreationists. The resulting net benefits to recreationists many times turn out to be less than those available in the first place. In addition, the borrow pits created during levee construction cannot be used to a significant degree by recreationists in this area.

27. Page 65, Channel Improvements Section - The assumption that water quality would improve in the long run as a result of channelization is not valid. On pages 12 and 28, it is reported that previous channel improvements have contributed to the degradation of the water quality in the subbasin. The references to increased water quality as a result of channelization should be deleted.

28. Page 69, Additional Study Needs, Number 23 - Though more detailed, Number 23 is totally subsumed under number 24. Number 24 implies an overall institutional analysis, which would study these same items and institutional entities not involved in water resources planning but whose actions impact upon those which are so involved.

29. Page 69, Additional Study Needs - It should be noted in each subbasin report that the probability of institutional and social boundaries being the same as subbasin boundaries is remote, at best. Since this boundary-overlap exists, integrated basin-wide social and institutional analyses are desirable.

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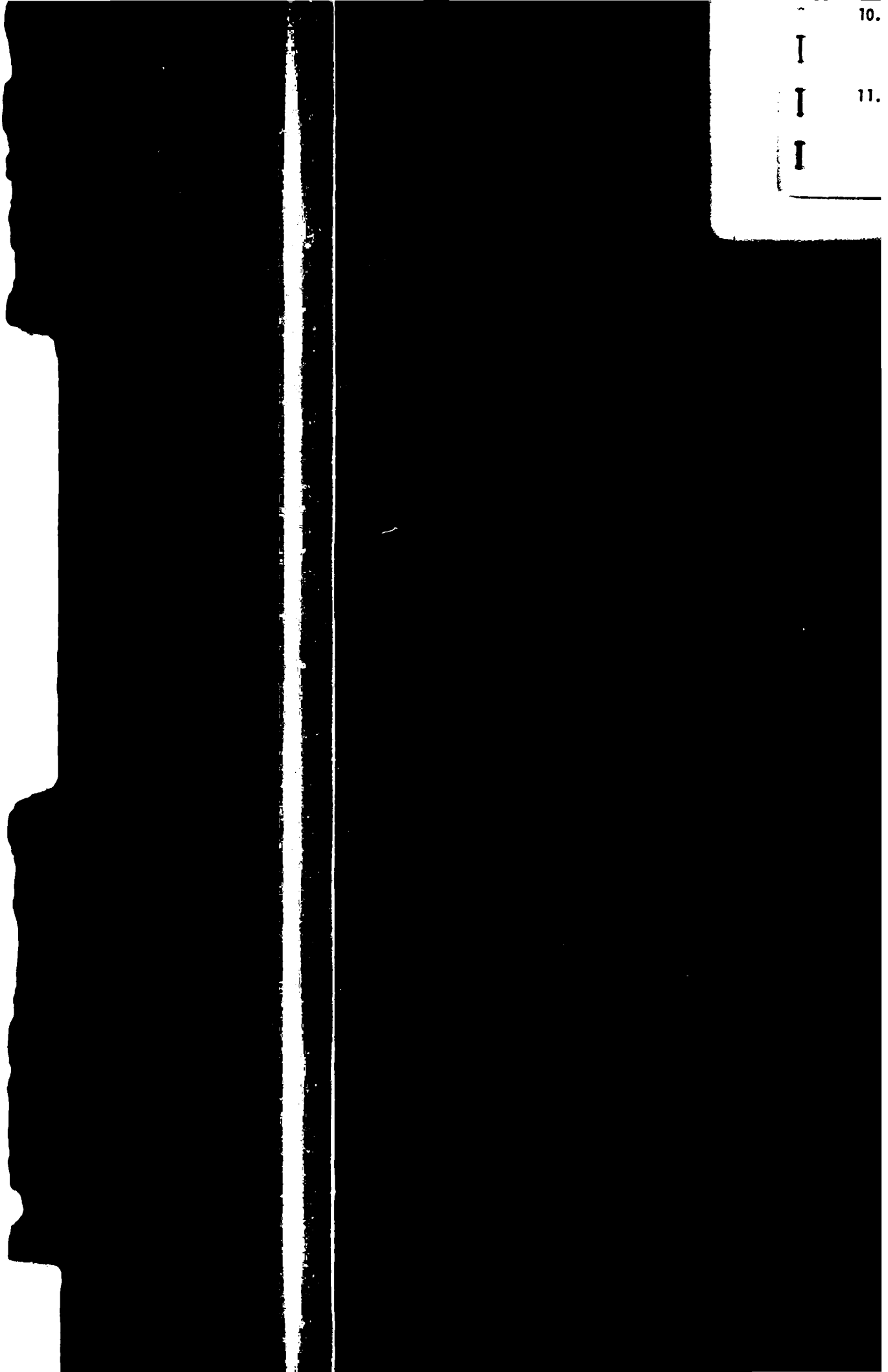
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